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The Chemical Age

VOL LXVI 26 APRIL 1952 No 1711

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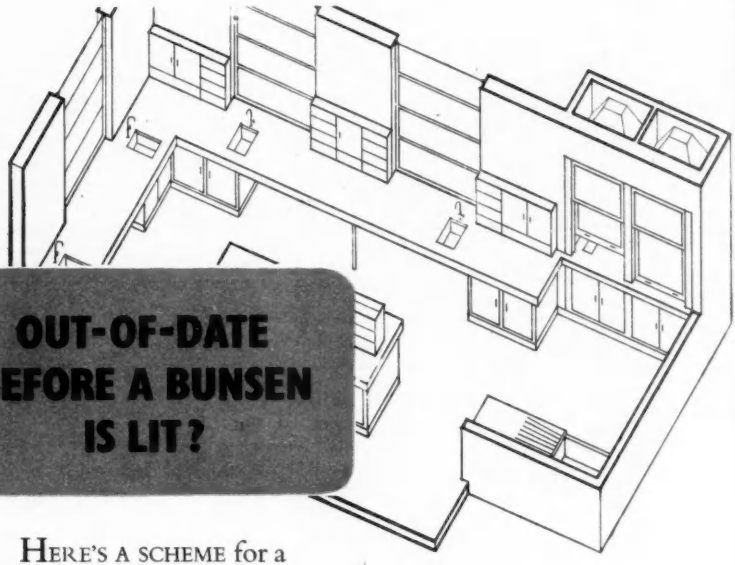

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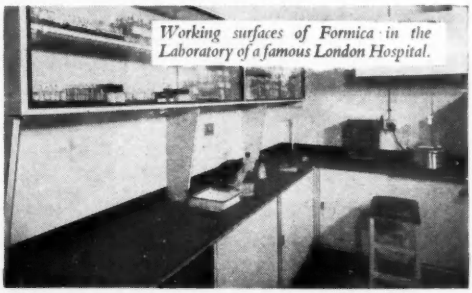

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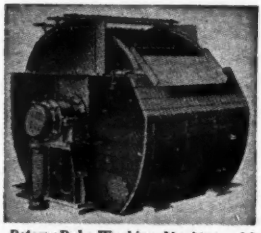

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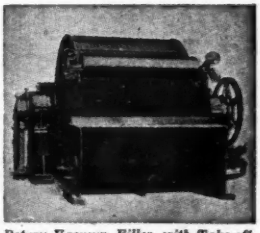

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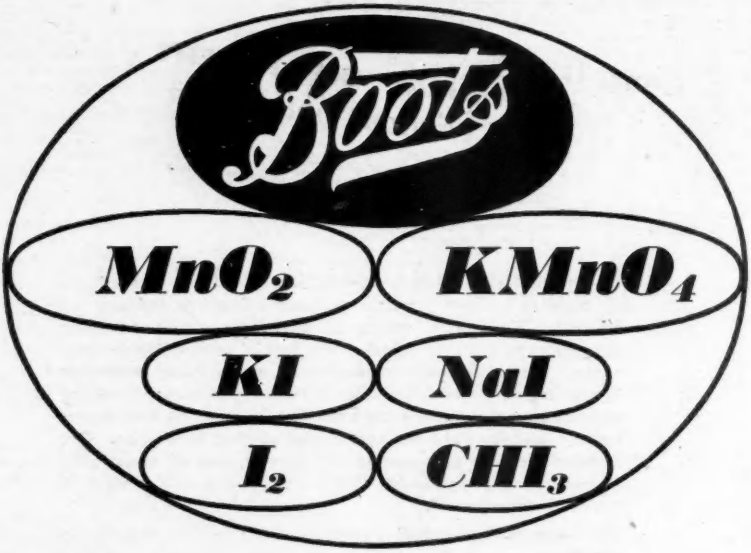

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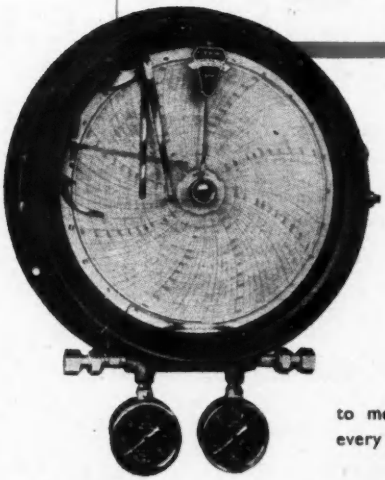

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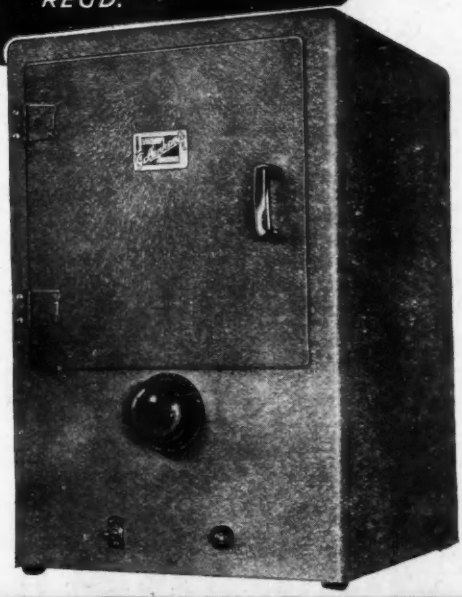

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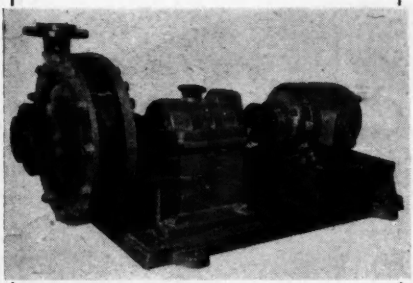

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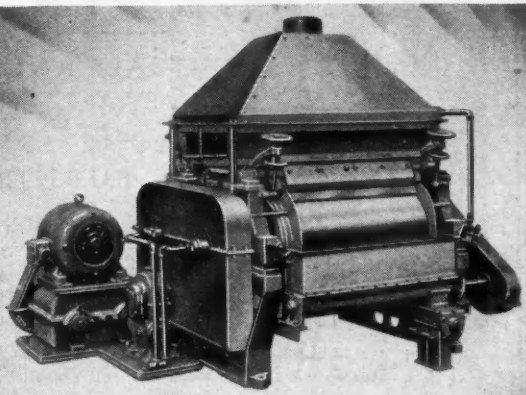

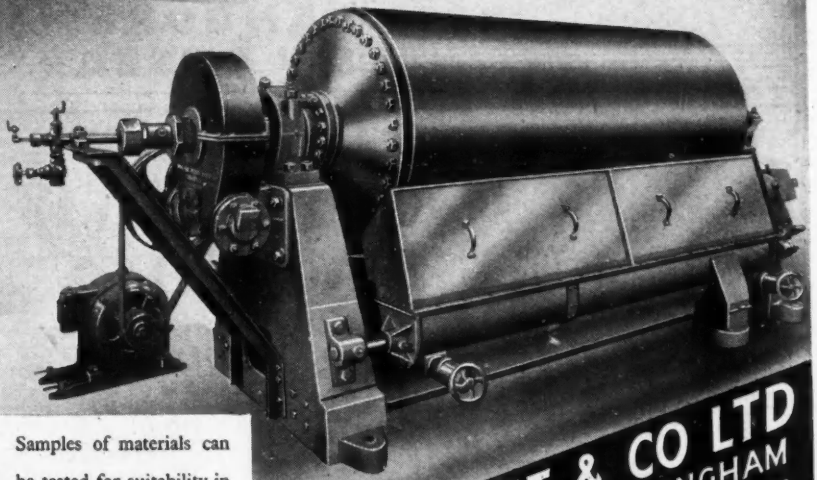

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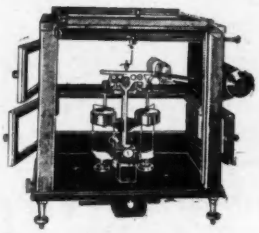

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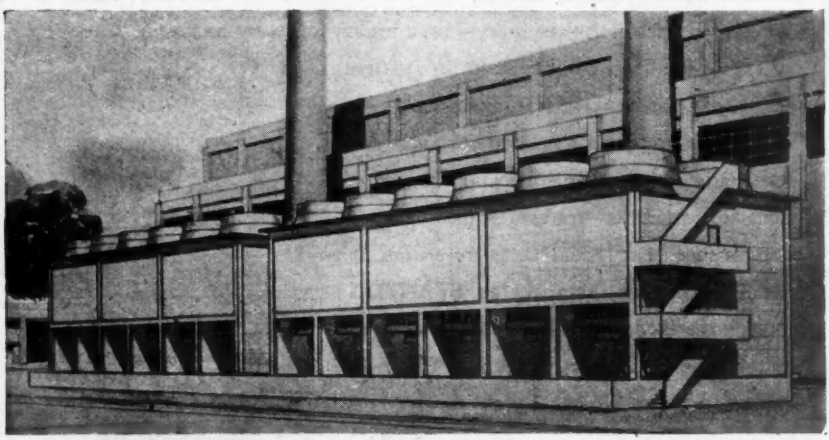

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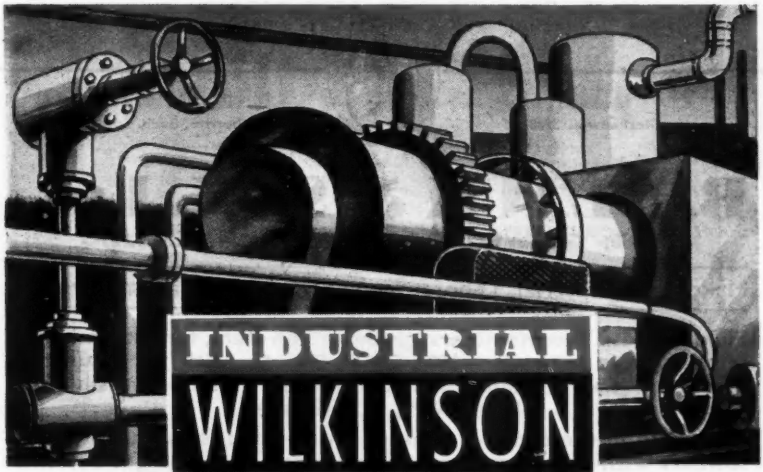

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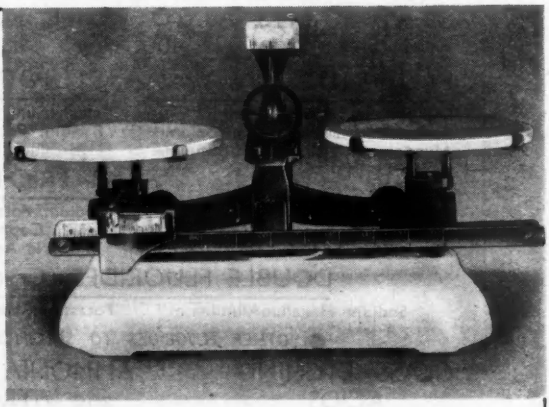

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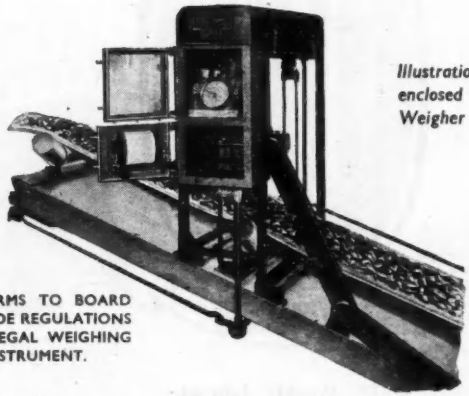

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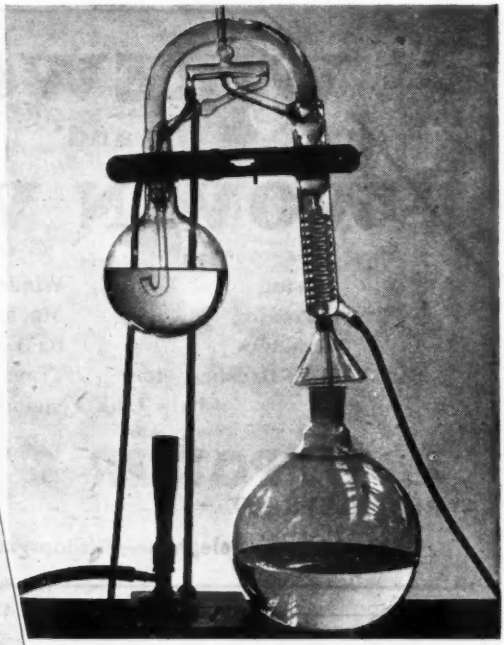

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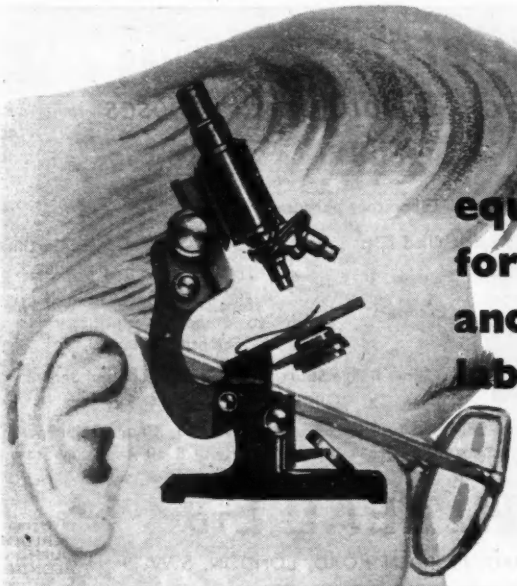

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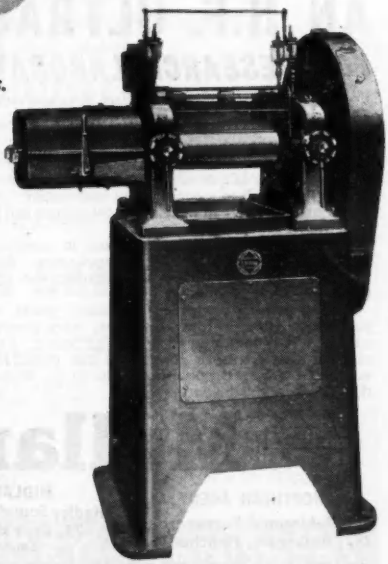

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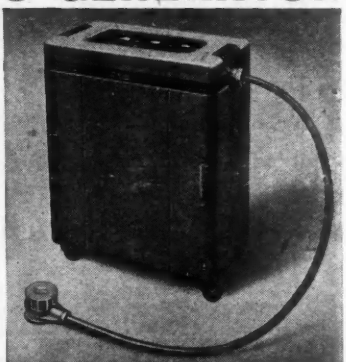

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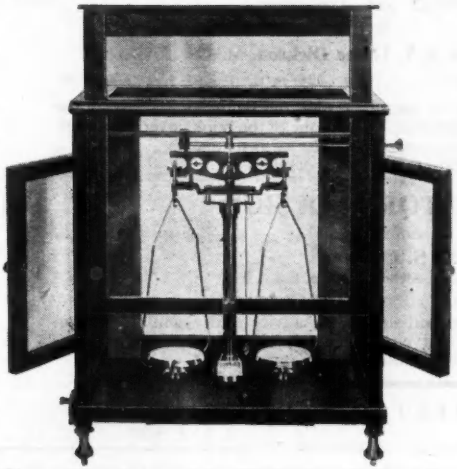

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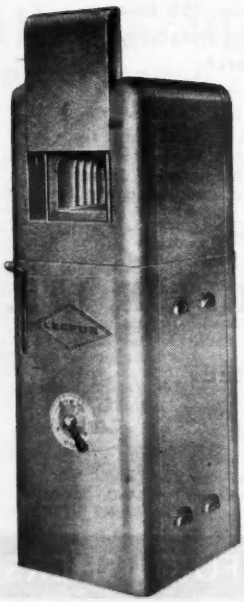

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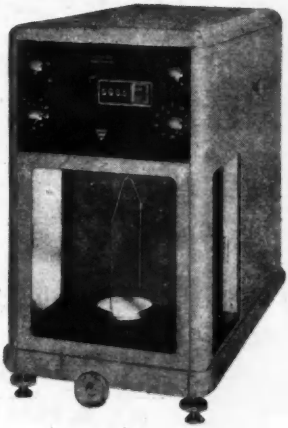

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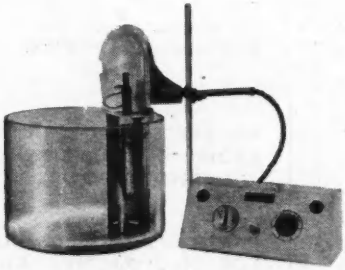

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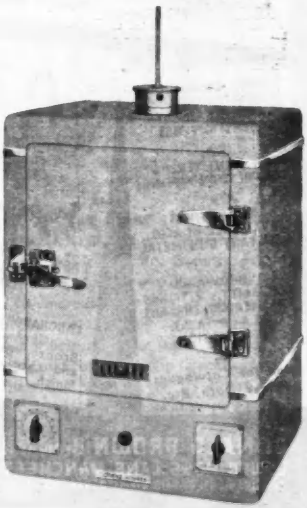

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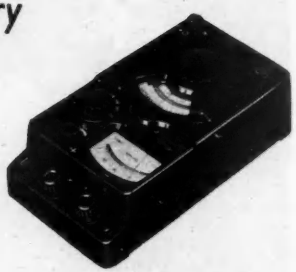

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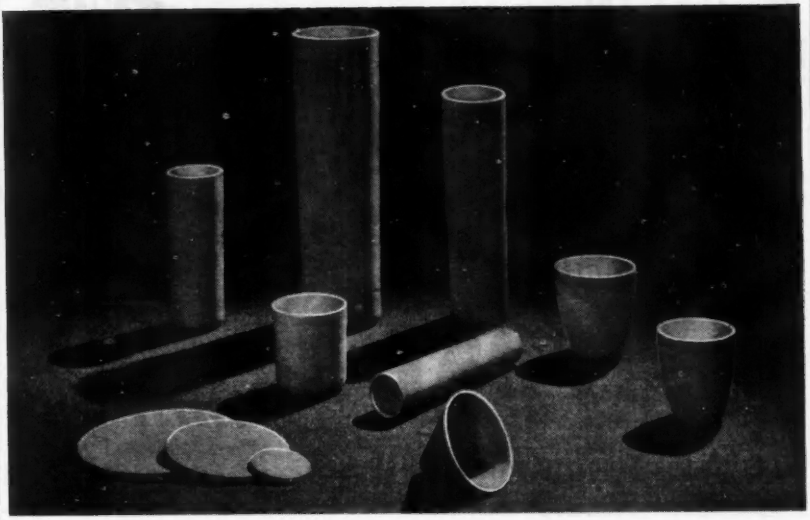

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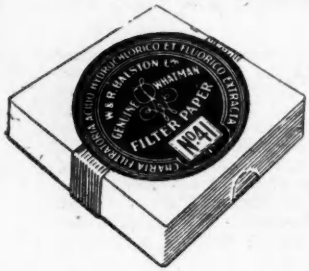

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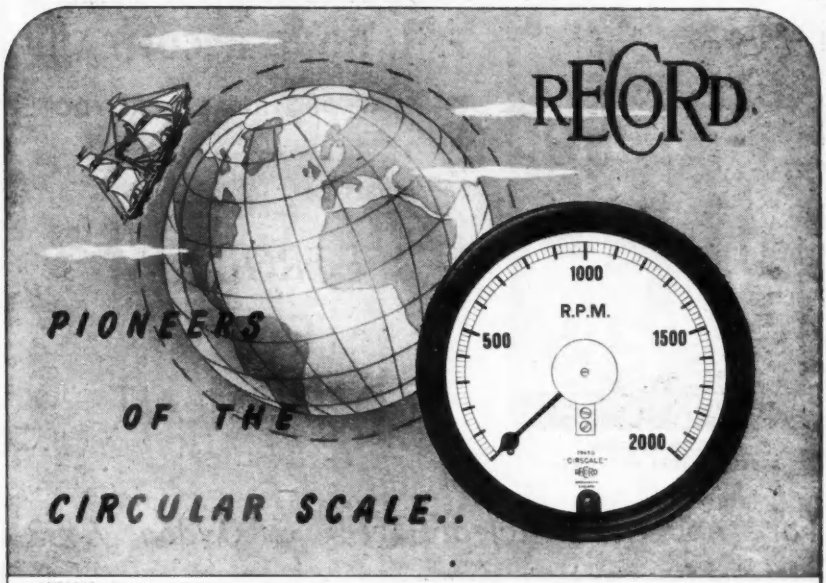

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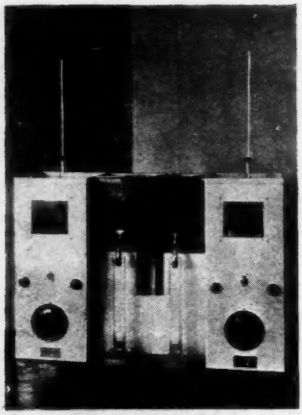

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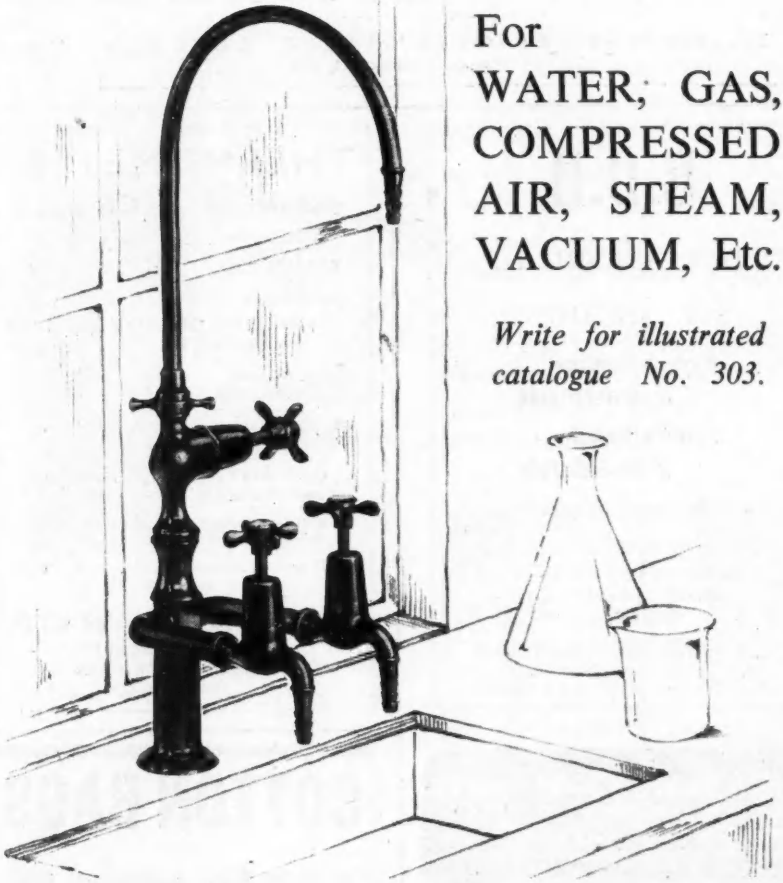

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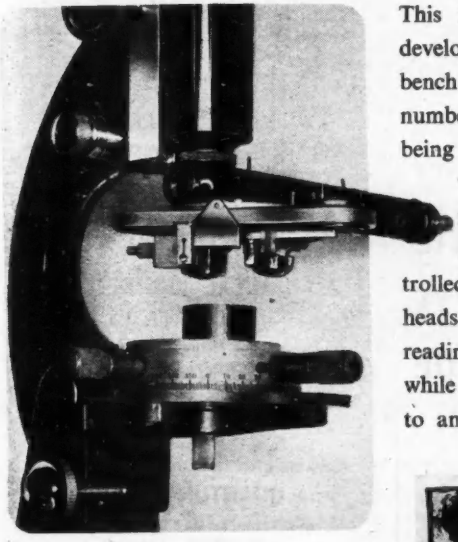

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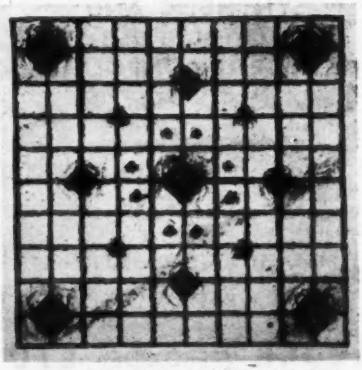

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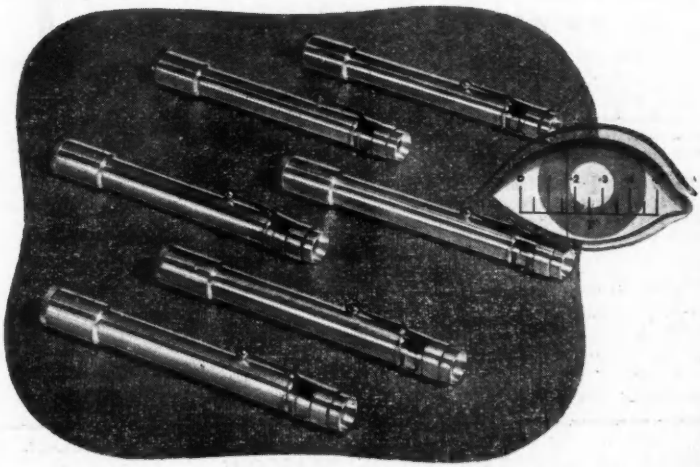

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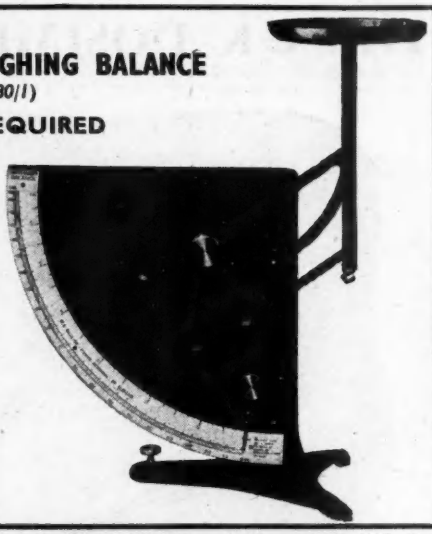

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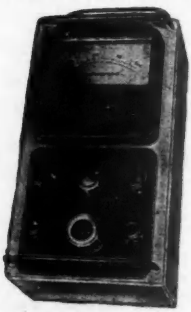

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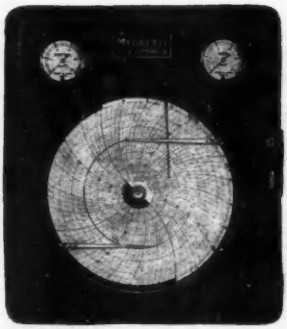

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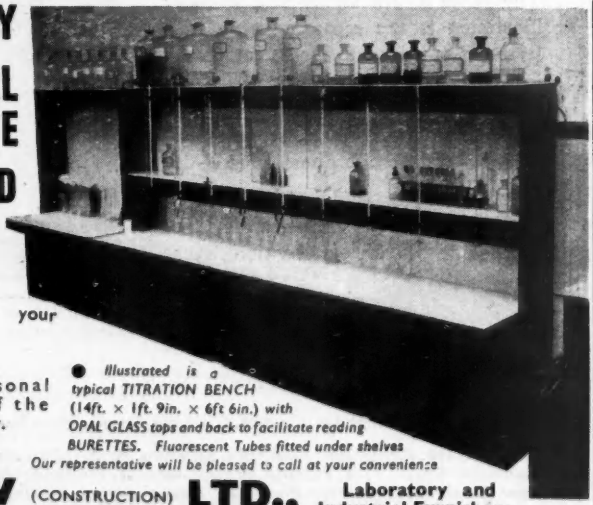

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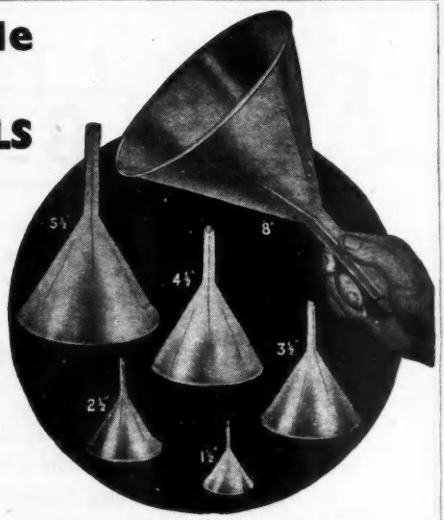

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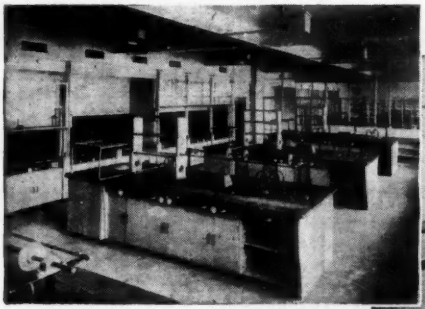

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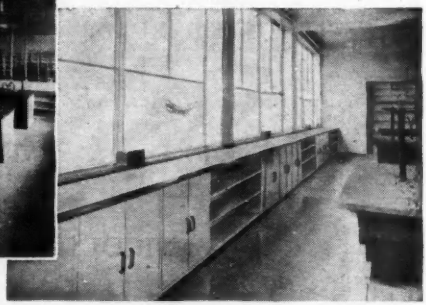

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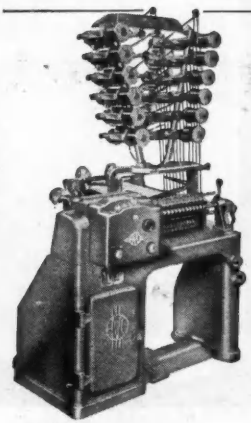

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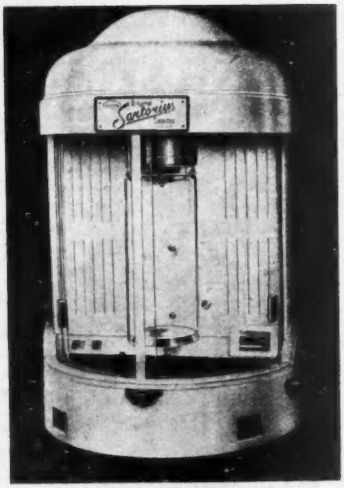

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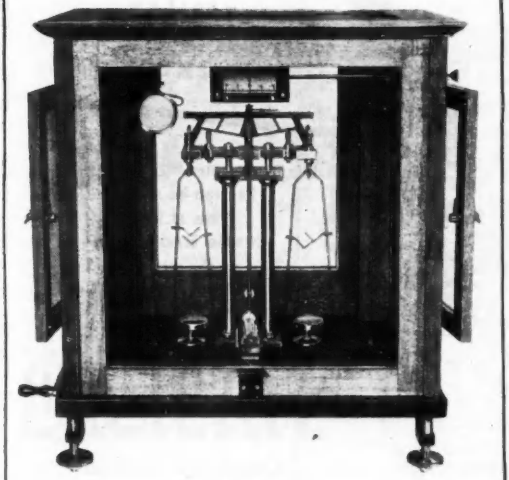

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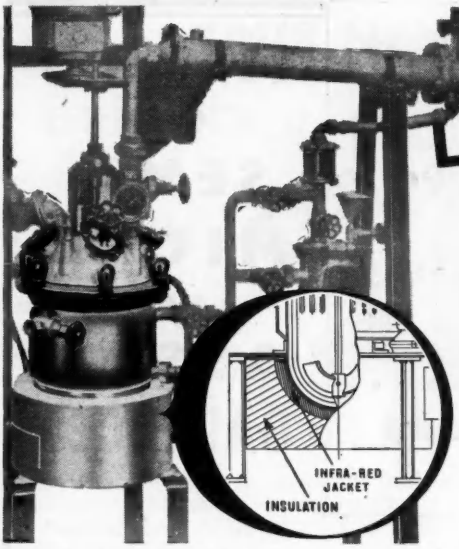

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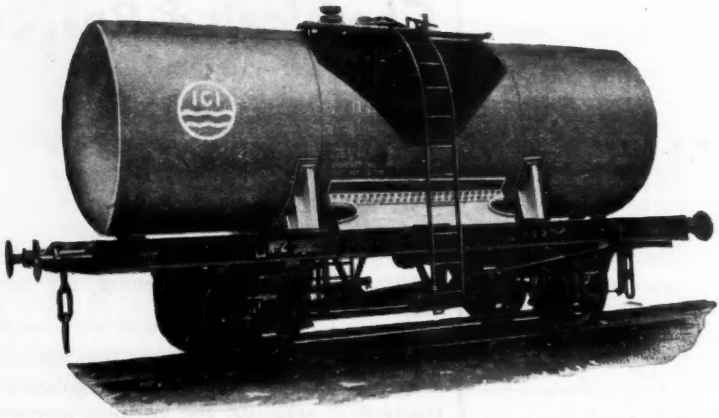
★ *This is one of a series of technical advertisements designed to advise Chemical Engineers and others of the extent of the Anti-Corrosion Service provided by DUNLOP. Other advertisements deal with soft rubber, butyl, P.V.C., neoprene.*

ANTI-CORROSION No. 2

EBONITE



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Volume LXVI 26 April 1952 Number 1711

Measure for Measure

IT is one of the hardiest dicta of modern science that nothing is known about a property or influence until it can be expressed as a number; if no generalisation is completely true, this at any rate is one to which there can be only rare exceptions. Today, whether scientists serve the cause of research or production, many more properties and influences are measured and with increasing frequency the accurate determination of quite small differences is called for. The demand for equipment and appliances to make all these measurements is therefore constantly expanding. It used to be said that the activity of a country's chemical industry could be assessed by its consumption of sulphuric acid; might it not similarly be said that the industry's efficiency and future prospects can be judged by its demand for instruments and apparatus? Nevertheless, few vital industries have faced as difficult a post-war journey as the British scientific apparatus industry.

In this similar issue for 1951 (CHEMICAL AGE, 1951, **64**, 617-8) a well-known member of that industry showed how the progress reached by 1950 had received unhappy set-backs through the 'panic-buying' that followed the Korean outbreak and then later from the demands of intensified rearmament; and, against this new background, the industry had no priorities similar to those it was given during the war. The 'promised land' of deliveries without delay from stock, so closely within sight at the end of 1950, had all too swiftly receded, the single section relatively free from this trend being the glassware apparatus section. Now, a year later, the general picture cannot be said to be greatly different. The artificial effect of panic-buying has been absorbed and its continued influence has become weaker and weaker. On the other hand, the effect of rearmament, both direct in demand and indirect in competitive impact (e.g., for electrical apparatus or its components), has steadily increased. Two decades ago difficulties in the supply of electrical components would not have seriously affected chemical laboratories; today the use of electrical equipment, both for analytical practice and process control, is substantial and rising.

In many branches of industry such a situation would be tersely described as the return of a seller's market, but this would most certainly be a phraseological slight upon the laboratory furnishing and scientific instruments industry. Throughout the long expansion of the chemical industry, this essential ancillary branch has followed a policy of seller-buyer

co-operation. The designers of equipment and the scientists of industry have on the whole worked in partnership and the ordinary trading relationship of buying and selling has been subsidiary, a lesser factor than the long-term influence of technical improvement and progress.

It is only necessary to recall the costly and voluminous pre-war catalogues issued by the leading houses for evidence of their co-operative outlook. It is no longer a practicable possibility for evidence of that kind to be regularly presented. Expansive catalogues require stable conditions. Last autumn one of the oldest British suppliers of laboratory equipment and apparatus issued the first volume of a new edition of its catalogue. This alone contained more than 800 pages. But the final proofs of some of its pages had been passed as long before as November, 1949, almost two years before actual emergence. Such are the difficulties of post-war publication.

Those who require apparatus must now play a more active part in finding out what is available from manufacturers. Greater attention might be paid to advertisements in scientific and industrial journals; and exhibitions, such as last year's innovation, the first exclusive exhibition of the British scientific instruments industry at Olympia in July, should be fully supported. If the time-honoured partnership between apparatus makers and apparatus users is to be maintained, the users must seek some of the information that they formerly received so easily. Today it is frequently the case that a customer must buy what he needs not where he will but where he can; not when he can but when he may. Yet this summary of the situation must not be looked upon as the crude 'take-it-or-leave-it' outcome of a sellers' market for apparatus and equipment. The British apparatus industry has greater wisdom than that and does not seek to take advantage of the difficult facts and conditions it must at present face and fight.

Price levels have inevitably increased, but here, too, the fullest co-operation of buyers is likely to be the principal influence through which price maintenance or even price reduction may come. It is an axiom of all manufacturing processes that costs tend to fall as the demand for the number of 'units' increases. A special piece of equipment that only a hundred laboratories or factories require must cost far more to make than one that is required by several thousand. The price of a piece of apparatus is considerably determined by the extent to which it can become a standard article. Here, no doubt, the export as well as the home demand should play its part; but the British industry, facing the effects of rearmament much more severely than some other European countries with good reputations as makers of equipment and apparatus, may well find itself at an increasing disadvantage in obtaining orders abroad. The main source from which standardisation of multiplicity-reduction must come seems to be the home market.

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The annual subscription to THE CHEMICAL AGE is 35s. Single copies, 9d.; post paid, 1s.; SCOTTISH OFFICE: 116 Hope Street, Glasgow (Central 3954/5). MIDLANDS OFFICE: Daimler House, Paradise Street, Birmingham (Midland 0784-5). THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers, Limited.

Notes & Comments

$CaCl_2$ in the Home

A SIZEABLE amount of retail business is being done in the U.S. with calcium chloride as a 'dehumidifier' in summer and a de-icing agent in winter. Chemists here must often have wondered why this traditional chemical of laboratory desiccators has not been developed for household use. The popular unit appears to be a 25-lb. bag. Considerable press advertising and other direct publicity has been used; with calcium chloride sloganised as 'the ever-thirsty chemical' and its contribution in the summer underlined by the phrase, 'it isn't the heat, it's the humidity.' However, retail selling depends also upon the buyer already having a dehumidifying appliance; for initial business both the dehumidifier unit and the bag of calcium chloride must be sold. Whether similar opportunities exist here seems open to question. Intense heat and humidity accompany each other less often in our summers than is the case in large areas of the United States; and when we have to face sharp winter spells salt is generally adequate as a dissipating agent for ice on paths and steps. There may be quite a few special uses for a simple calcium chloride dehumidifier, however—stationery stores in small offices, damp cupboards in old houses, etc.

Rare Earths

THAT history depends entirely upon the viewpoint from which it is considered was neatly proved by two chemical journals that recently arrived on the same day. In *Chemistry & Industry* (12 April) an editorial article drew attention to the fact that 1952 was a double centenary year for rare earth chemistry, for in 1852 William Hisinger, discoverer of cerous oxide, died and Demarçay, separator of some of the rarer rare earth metals, was also born in that year. But in the issue for 29 March of *Chemical Week*, arriving by the same post, an article had the title, 'Rare Earths Arrive.' The contradiction is, of course, not as paradoxical as it sounds. To 'arrive' in the American sense is to possess potentialities for big business. The displacement of gas lighting by electricity pushed the rare earths out of the big business class where at least they had been represented by thorium in the mantle-making industry. Now cerium is steadily penetrating the metal alloy industry and glass containing cerium is extensively used in atomic radiation optical equipment. Lanthanum is also finding a place in the glass lens industry; lanthanum oxide was used during the war for glass for aerial camera lenses and it is reported that similar glass is being used by Eastman Kodak for all high quality camera lenses. But the biggest potential market for the rare earths is probably their use as catalysts in oil cracking. Their high cost is the principal deterrent to expansion in industrial use, but costs will fall as demand increases. According to one American authority, the method of production now employed—calcium reduction of the rare earth halide salt—costs $15 per lb. for small lots, $10 to $12 per pound for 100 lb. lots. and only $2 to $3 per pound for ton quantities.

Undoing the Good Work

ADVERTISING works two ways, for and against things, and the pharmaceutical industry in America is reported to be having trouble with the latter variety. This is being caused by that thorn in the flesh of many a worthy citizen before now—the people who write plays. A play written by Sigmund Miller called *One Bright Day* opened in New York in March and told the story of a slightly dubious pharmaceutical company which discovers that its product—on sale in countless medicinal preparations—is toxic under certain conditions. The humanitarians, who include the president of the company, win in the end, but virtue is nearly defeated by the 'public-be-damned' group whose outlook is purely commercial. What the pharmaceutical industry is said to be

worried about is that people seeing the play may come away with the idea that real-life pharmaceutical companies are not really so very different from the one depicted on the stage, and that the results of their preparations are equally chancy. Unfortunately for the industry there is no safeguard against this sort of thing, any more than there is against letters to *The Times*. Many a public person has found himself lampooned by someone with more wit than respect, and, more irritatingly still, has later discovered that the barb has stuck. Nobody's morals, however, are quite above reproach, and if the playwright is guilty of misrepresentation, who can deny that industrial advertising rarely contains just 100 per cent factual truth, particularly in the United States.

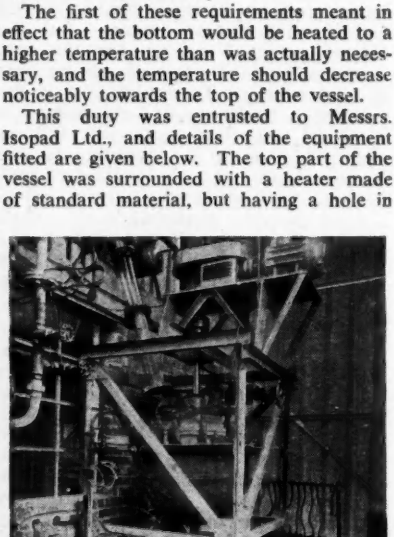
An Unusual Heating Problem

HOW to heat a 40-gallon reaction vessel so as to simulate direct-flame heating, while being able to remove the source of heat almost instantaneously should a reaction show sign of becoming exothermic, was an unusual heating problem on a pilot plant which occurred recently.

The first of these requirements meant in effect that the bottom would be heated to a higher temperature than was actually necessary, and the temperature should decrease noticeably towards the top of the vessel.

This duty was entrusted to Messrs. Isopad Ltd., and details of the equipment fitted are given below. The top part of the vessel was surrounded with a heater made of standard material, but having a hole in the base large enough to enable a mantle with quartz fibre insulation to fit round the base. The mantle, being operated at a higher temperature, provided the high temperature zone needed round the base of the reaction vessel. The reaction vessel was to be emptied through a 1.5 in. Cooper Gate Valve which had had the handwheel extended 12 in. from the centre line of the vessel.

In order to enable the heating element to be withdrawn quickly, a special design had to be made. The high temperature mantle was slotted so that it could be withdrawn horizontally. The hole in the upper mantle enabled it to be slipped over the extended handwheel of the outlet valve.



The Isopad Heating Mantle in the lowered position

Daily Beauty Treatment

TO encourage the essential cleanliness essential in the pharmaceutical section of its Linlithgow factory, I.C.I., Ltd., Dyestuffs Division, has provided a 'powder-room' in which the 280 girl employees go through a daily beauty routine before starting work.

Outdoor clothes are discarded and clean nylon overalls slipped on; in the same way the firm provides clean white canvas shoes to replace the outdoor wear. Hair is covered in a special turban and then a thorough scrub undertaken in the washroom. In return the firm provides free cosmetics, lipstick, powder, cream, tissues and nail varnish.

The 'powder room' is a spotless, pleasant place designed for use by large numbers of girls at one time. This accent on complete hygiene pays dividends, in assuring perfection of handling of the products involved.

Additional amenities include a staff laundry, canteen and other facilities.

The Physical Society's Exhibition

Steady Progress During 1951

THE annual display of instruments and apparatus organised by the Physical Society was held as usual in the Huxley Building and Imperial College from 3-8 April. Lectures upon 'Engineering Supersonic Aerodynamics' and the 'Physical Basis of Colour Photography' were arranged and there was a display of the prizewinning entries of the Craftsmanship and Draughtmanship Competition, the prizes for which were distributed on 7 April.

This year's Exhibition, although complete and exhaustive, had not the appeal of previous occasions, and the intervening year must be credited with steady progress rather than sensational development. An encouraging feature is the continued interest of the Government Research Establishments and other large organisations not immediately interested in the sale of instruments. It seems unfortunate, however, that these displays are still confined to the most cramped and crowded of the exhibition rooms. Although there is still an appreciable amount of equipment designed solely for work with radioactive materials the amount was less than in previous years and this field of research is no longer the central and dominating theme of the show. On the other hand the amount of material which is of direct interest to the chemical industry was also less this year and many of the exhibits had been on show before.

Large Instruments

The most interesting of the larger instruments on show was the D.C.L. Infra-Red Gas Analyser which has been developed by the Distillers Co., Ltd., to examine and monitor the gas streams from cracking processes, although its applications are far wider than this.

The instrument uses a chopped beam of infra-red radiation which is detected upon a lead sulphide cell, and in fact the employment of two such beams and a phase-sensitive detector system makes the whole self-balancing while a compensating comb produces zero dispersion. The characteristic absorption spectrum of the hydrocarbon in the 2μ region is used and although the instrument is not intended to measure trace quantities, an accurate measurement of the concentration of a hydrocarbon in the gas stream can be made even in the presence of another hydrocarbon whose absorption bands partially overlap.

Two models have been developed, a single component recorder which will indicate the percentage of one major component in a gas stream, i.e., the purity of ethylene in a mixture containing 90 per cent of ethylene and the residue consisting of higher hydrocarbons, and a multicomponent model which records the concentrations of up to six constituents of a gas stream upon a six-point recorder. The latter has push button selection of components and can be operated automatically or manually. The lead sulphide cell and glass windows may be replaced if desired by a Go Lay infra-red detector and silver chloride windows.

X-Ray Powder Camera

Unicam Instruments (Cambridge), Ltd., were showing a new high-temperature X-ray powder camera for the examination by X-ray diffraction photography of the changes in crystal structure occuring at temperatures up to 1,400°C. The heating is provided by a platinum-rhodium resistance element and the heat is concentrated upon the specimen by two hemispherical platinum shells and reflector bowls, the whole mounted in a water jacket with a rhodium-plated internal surface. The temperature is registered upon a thermocouple which may be hand-scanned to estimate the temperature gradient. The diffraction pattern is recorded using the conventional 19 cm. ring type camera which is completely isolated from the evacuated chamber and may be removed and reloaded without interference with the vacuum or the temperature inside the furnace.

Alignment with the X-ray source is ensured by accurate location using the V-slot and plane method. The top half of the furnace and evacuation chamber are removable and contain the holder for powder specimens which may be rotated. The holder for solid block specimens is located in the lower half and may be oscillated through 6° or scanned in a vertical direction. The specimen may be examined in a vacuum

or in a gas such as hydrogen or nitrogen.

On the stand of Messrs. Hilger & Watts, Ltd., were two attachments for extending the scope of their established equipment. The first of these is a photoelectric scanning unit for spectrographs which may be used for the recording of spectra in the ultra-violet region. It has been developed in conjunction with I.C.I. to record variations in spectrum intensity observable with the Hilger Medium Quartz Spectrograph. For this purpose the conventional camera is replaced by a slit which is driven by a synchronous motor to scan the spectrum between 2,000 and 8,000 Å, the light passing the slit being reflected on to a photomultiplier tube by a small mirror. The output from the photomultiplier tube is fed to a mirror galvanometer the movement of whose mirror is recorded on a daylight-loading drum camera.

Metal Concentrations Determined

The second device was the Flame Photometer attachment for the Uvispek Spectrophotometer which enables the concentrations of certain metals in solution to be determined. The method involves the comparison of spectrum line intensities emitted by the solution with those obtained from a standard solution, and this enables a wide range of concentrations from trace quantities upwards to be measured accurately. Hydrogen is used as the fuel and is fed to a number of small holes surrounding the pipes which carry the atomised solution to the flame. The spray is formed in an electrically heated pyrex chamber when the oxygen feed is turned on and is led directly to the water-cooled burner. Light from the high-temperature flame falls directly upon the entrance slit of the monochromator.

The interest which has been shown by research workers in the potentialities of flame photometry as an analytical method was reflected in this year's exhibition by the appearance of several other models. A simpler and more restricted instrument, the EEL Flame Photometer, shown by Evans Electroselenium, Ltd., may be used for the determination of sodium and potassium in solution. The flame is produced by town gas and compressed air and the light emitted by the atomised solution passes the appropriate filter and falls upon a single photocell, the output of which is indicated by a galvanometer. Full-scale deflection is obtained with concentrations of about 1 mg. in 100 ml.

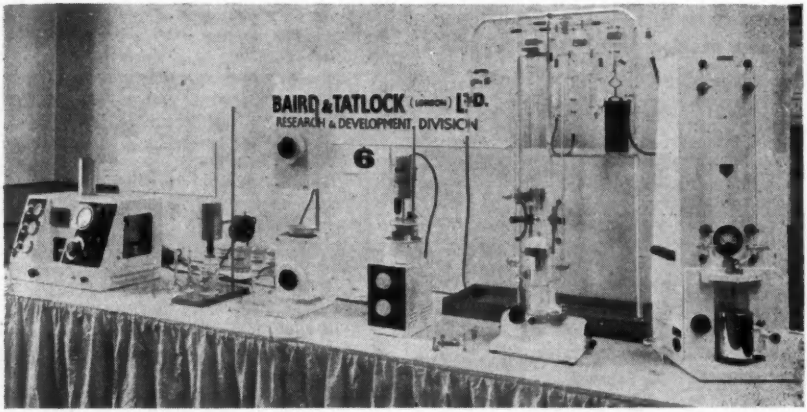
A more complicated design appeared on the stand of Messrs. Baird & Tatlock, Ltd., incorporating the use of a separate photocell for sodium and potassium determinations. The output from the selected photocell is fed to a balanced triode valve bridge and the resulting output is fed to a second bridge whose output is indicated upon a galvanometer. The galvanometer reading is adjusted to zero by applying an opposing E.M.F. to the first bridge to remove the unbalance, and the reading on the potentiometer controlling this operation is a function of the concentration of the metal in solution. The instrument is standardised with a solution of known concentration, oxygen and butane supply the flame and the light emitted is focused by a highly efficient optical system upon the photo cell.

A medical Flame Photometer was also exhibited by Messrs. Hilger & Watts, Ltd. It is a fairly simple instrument, the burner gas being used to atomise the solution and deliver it to the burner. The concentrations of calcium, potassium and sodium in biological fluids can be estimated by comparison with an internal standard and the use of photo-conductive cells enables a robust indicating meter to be used.

General Laboratory Equipment

There were more *p*H meters on show this year, four of the eight or so manufacturers exhibiting a range of models. The direct reading *p*H meter on the stand of W. G. Pye & Co., Ltd., has two overlapping ranges of 0-8 and 6-14 displayed upon a large dial. The use of a large amount of 'negative feed back' has reduced the temperamental character of this type of instrument to a condition where the accuracy is unimpaired by variation in mains voltage and valve characteristics. Under these conditions the response is almost linear and zero drift with variations in voltage or frequency is very small.

In addition to a battery-operated portable *p*H meter, the stand of Electronic Instruments, Ltd., contained an Industrial *p*H Transmitter designed for the recording and control of *p*H in industrial processes such as gelatine manufacture, electroplating and paper manufacture. A range of meters shown by Doran Instrument Co., Ltd., included the Dual titrimeter, an electrometer



The stand of Baird & Tatlock (London) Limited

valve voltmeter, which has been adapted to allow two electrometric titrations to be carried out simultaneously, and the battery-operated Mini *p*H meter. Muirhead & Co., Ltd., exhibited their high-alkali *p*H electrode which measures to *p*H 13.5.

Among the collection of high-vacuum equipment displayed by W. Edwards & Co., Ltd., was a four-stage mercury diffusion pump which can be used for gas sampling and noiseless unbacked pumping. The unit contains three stages backed by a final ejector stage and with a power input of only 850 watts will operate against a backing pressure of 25 to 30 mm. The pumping speed is between 60 and 70 litres per second and the pressures obtained are below 5×10^{-3} mm. of mercury.

For the measurement of pressures between the ranges of 1 to 10^{-3} and 5×10^{-3} to 10^{-5} mm. of mercury the company have produced a Combined Phillips Pirani Vacuum Gauge. This combined instrument provides a compact wide-range gauge suitable for high-vacuum systems in which roughing and fine side conditions have to be measured, e.g., in vacuum-coating plants.

Also on show was the Cartesian Manostat designed to regulate a system at a fixed vacuum or pressure, or act as a control valve for gas flow under similar conditions. The diver (an inverted cylindrical tube with a closed end) floats on mercury and closes an orifice when it rises due to differential decrease in pressure on its outside. The inside of the diver is connected to a tube containing a fixed quantity of gas at the reference pressure.

A small mercury diffusion pump appeared on the stand of the Fuel Research Station. The unique feature of this pump is the use of a cold finger condenser with a concave surface on to which the mercury vapour stream impinges from a small jet. This enables the total volume of the pump to be made quite small and makes it suitable for the collection of small gas samples.

For distillations at a pressure of one micron or less, Quickfit & Quartz, Ltd. have produced the Semi-Micro Molecular Still. This consists of a heated tube with an internal metal spiral down which the liquid flows. The volatile constituent is flashed off and collected on a water-cooled internal concentric tube. The distillate is collected by a weir and runs into a small flask, while the residue is collected at the base of the outer tube. The whole apparatus, which is symmetrical, is then inverted, the temperature of the outer tube raised, and a further volatile constituent collected as before.

Griffin and Tatlock, Ltd., were displaying equipment for precise fractionation of small quantities of liquids. This included an 18 in. high-efficiency fractionating column together with manual and automatic take-

Stanton Instruments' stand showing their new self-operating balance (Model B.A.10)

off heads. At a reflux ratio of 25 to 1 the time taken to collect 100 ml. is 6 hours.

Balances

Probably the most startling exhibit in this year's display, and the most significant advance in chemical balance manufacture, was the Stanton Model B.A. 10, a self-operating electronic balance. This balance consists of three units connected together by multiway cable which allows convenient disposition of the units. The balance unit is in effect a motorised weight-loading balance similar to the earlier model B.A. 5, but with electric motors operating the balance action and weight-loading camshafts. The remote graticule reading and beam deflection are determined by means of photo-cells.

A lens mounted at the end of the balance pointer deflects a ray of light which strikes one of two photocells when the beam has reached full deflection. These photocells, which are mounted under the roof of the balance case, determine whether the applied load is too light or too heavy. In addition the balance pointer carries a small mask which swings across a third photocell mounted at the rear of the pillar. The swing of the mask across the cell causes its output to vary in a manner which is proportional to the beam deflection. This output is fed directly to a microammeter incorporated in the reading unit.

Variation of light intensity from the projector lamps which illuminate the photocells is avoided by the use of a constant voltage transformer. The control unit contains the power pack for the operation of the balance and the operating controls. The output from the photocell reading the beam deflection is used to trigger a thyratron whose anode current closes a relay to complete the appropriate motor circuit. Electrical interlocks are so arranged at all stages so that the weight loading camshafts can only stop when the weights are either on or off. Multi-point cams situated on the end of each weight-loading camshaft interrupt micro switches at the appropriate points, and the pulses so obtained are used to operate a similar series of cams in the reading unit. The action and arrestment and all other operations are controlled by a single push button. The reading unit is connected to the control unit by a twelve-way cable, and incorporates a three-dial motored repeater which follows the positions of the weight loading camshafts in the balance. Readings of the last two decimal points are given on the large microammeter coupled directly to the photocell. The zero position and sensitivity of the balance can be matched by means of potentiometers.

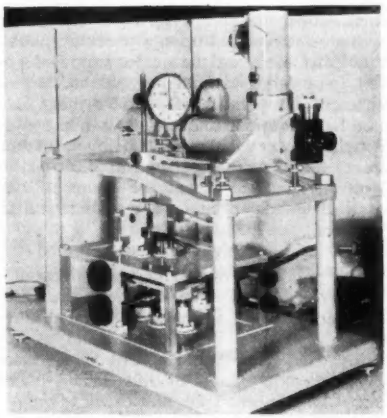
The method of use is to place the load upon the balance pan and throw a switch into the operating position. The control button is then pressed and the weight appears upon the reading unit in a short while. When the weight has been recorded the control button is again pressed to arrest the movement and the switch set to the home position, when the balance automatically returns to the rest position. The reading unit may be up to 100 yards distant from the balance itself, and this feature has been developed for the requirements of the Ministry of Supply.

Although the model exhibited is only claimed to be a demonstration instrument, the manufacturers have declared themselves ready to discuss the making of such balances giving a range of plus or minus 5 to 10 gm. for use with known tares. Stanton Instruments, Ltd. maintain that much routine analysis could be carried out within these tolerances and larger variations could be covered by manual weight loading.

Also upon their stand was an improved model of the Hales Moss Gas Specific Gravity Balance which can measure the specific gravity of gases from 0 to 2,000 relative to air at N.T.P. with an accuracy of 0.005. The new design has made it possible to carry out the whole determination with the balance case closed, the glassware being accommodated upon a separate outrider deck and the poise adjuster now being operable from outside the case.

Griffin & Tatlock, Ltd., were showing their well-known Microid Lever Balance, and J. W. Towers three of their range of Automatic balances.

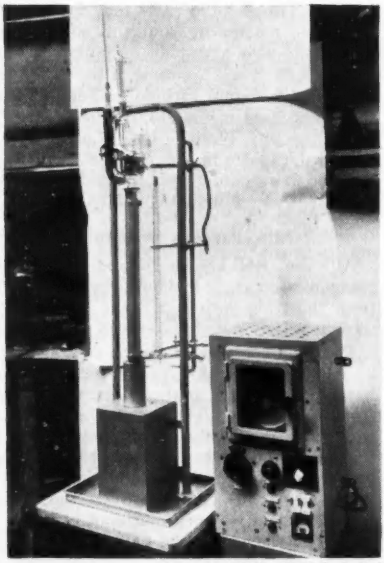
Demonstrated at the Exhibition in connection with balances was the Oertling Releas-o-Matic device. This is based upon a somewhat extensive research carried out in the Oertling laboratories to determine the main causes of loss of sensitivity in chemical and micro chemical balances. The results have shown clearly how precision is adversely affected by blunting of the knives as a result of successive releases of the beam and how the initial fine edge can be maintained for a much longer period by reducing the velocity of impact of the knife-edge on the plane when the balance is set swinging.



Oertling research laboratory apparatus for measuring knife-edge radius to a few millionths of an inch

Extensive laboratory tests involving several million weighing operations were made possible by a special device developed in the Oertling research laboratories. It is claimed that the introduction of the Oertling Releas-o-Matic device represents a major advance in design of analytical balances, an advance comparable in importance with the earlier introduction of relieved knife-edges, now universally applied in precision balances.

Another instrument to which electronic methods have been applied is the microscope. Avimo, of Taunton, had on display the Aviscope, a device which might be called an electronic microscope, although the only feature that it has in common with the electron microscope is the display of the image upon a cathode ray screen. The object, which may be living cellular tissue, is scanned by the light emitted from a flying spot generator *via* a reversed ultra-violet



(Courtesy Griffin & Tatlock, Ltd.

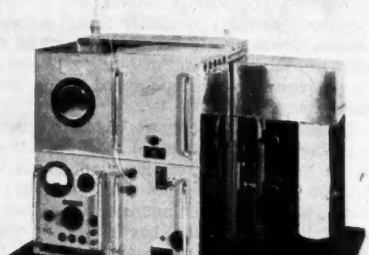
18" High-efficiency fractionating column

microscope. The resulting modulated radiation is received upon a precision photo-multiplier tube, and the output amplified and fed to a large cathode-ray screen. This arrangement permits of variable magnification and contrast and allows a number of people to view the magnified image at one time. The development and applications of electron microscopy was the theme of one of the stands occupied by Metropolitan Vickers.

Light Sources

The possibility of producing luminescence in certain substances by the effect of a varying electric field has been investigated since before the war. Upon the stand of the British Thomson-Houston Co., Ltd. there was a demonstration of this effect. The electroluminescent light emitted by the phosphors shown was green and blue in colour and of very low intensity; but further development is hoped to increase the output. The stand of the General Electric Co., Ltd., also contained a demonstration of electro-luminescence and the construction of such a light source was described as a sandwich of a dielectric containing the phosphor, usually zinc oxide or sulphide, between a metal sheet and a layer of glass having an inner conducting surface.

The crater lamps exhibited by Ferranti are three electrode mercury-argon filled tubes whose light output is proportional to their anode current. They can be used in the recording of sound or pictures. Of similar construction are the spectral-source lamps which are filled with neon, helium, argon or mercury vapour.



[*Courtesy J. W. Towers & Co., Ltd.*
Automatic distillation apparatus

The interest in the semi-conducting properties of germanium continues to increase, and this year there were no less than five companies exhibiting germanium crystals or rectifiers. Marconi Instruments, Ltd., showed a single hexagonal crystal in which the normal tetrahedral growth had been inhibited by the method of solidification, while the General Electric Co., Ltd. displayed a single germanium crystal grown by the slow withdrawal of a seed crystal from a melt at a controlled temperature. Other displays showed germanium crystal diodes and triodes of various types.

A year ago Murex, Ltd. announced the production of zirconium on a commercial scale and this year they have been able to exhibit this metal in the form of wire, rod tubing and sheet, the latter being up to 20 in. in width and 3 ft. in length. The possibility of using chemical plant made from zirconium metal is one which will attract the chemical engineer, whose problems are those of corrosion rather than cost. This possibility is made practical by the discovery that zirconium may be welded satisfactorily with the argon arc or by spot-welding. In addition parts may be spun or drawn or machined from the solid ingot. There was also a display of tantalum tube and spun parts and a sample of the extremely refractory tantalum carbide. Tantalum was also being used in the electrolytic capacitors shown by the Plessey Co., Ltd. These polarised capacitors are extremely small in size and can operate over the wide temperature range of −70°C. to +200°C.

Miscellaneous Apparatus

All the well-known laboratory supply companies occupied stands this year, and from the wide variety of their products on show it is only possible to select a few items.

The Sedimentation Balance demonstrated by A. Gallenkamp & Co., Ltd. uses a torsion balance to weigh particles as they settle from suspension. The balance is sensitive enough to permit the use of very low concentrations of solids and thus settling under practically 'free falling' conditions occurs. This accuracy is obtained by means of an optical system which projects an image of a graticule attached to the balance pointer on to a screen, thus allowing direct readings to be made.

J. W. Towers & Co., Ltd., displayed a

model of an Automatic Distillation Unit originally designed by the Shell Development Co. for the automatic reproduction of A.S.T.M. method D-86. The operator merely fills the flask with the liquid to be analysed and inserts a chart upon the drum. Upon setting the heater control the apparatus automatically plots a graph of the volume of distillate against the vapour temperature. The first drop of distillate momentarily obscures a photocell and operates a relay setting the pen on the chart which is rotated by the rising meniscus in the receiver. At the end of the distillation the vapour temperature falls, the drum rotates backward and switches off the heater current.

Sunvic Controls, Ltd. exhibited a Resistance Thermometer Controller which could be used in conjunction with a platinum resistance thermometer to control furnaces operating between the temperatures of 300° and 1,100°C. The thermometer is connected to a bridge circuit and any 'out-of-balance' signal is amplified by a two-stage amplifier with gain control for sensitivity. In the output stage a thermal cycling energy regulator is operated by a double-diode triode, the two anode currents being fed in antiphase to two heater windings on a pair of bimetal strips. Under zero signal conditions the two anode currents are equal and the two strips remain parallel, but they will move to or from each other according to the sense of any 'out-of-balance' signal. The relative position of the two bimetal strips controls the ratio of the 'on-off' times when an additional current, switched at the same time as the load, is passed through one of the bimetal heater windings, causing cycling action and giving proportional control.

On the stand of the Atomic Energy Research Establishment was a 'mass flowmeter' for liquids, an adaptation of the Kronberger flowmeter for gases which was exhibited in 1946. The liquid passes through a narrow thin-walled tube with a heater in the centre. This short heater coil sets up a temperature distribution along the length of the tube. When the liquid is at rest this distribution is symmetrical, but motion along the length distorts it, and the temperature in the first half of the tube falls, while the temperature in the second half rises. These temperature changes are integrated by two platinum resistance thermometers, one wound on each half of the tube. The two resistances form the two arms of a Wheatstone bridge and the 'out-of-balance' current is proportional to the flow of liquid through the tube. Flows as small as a few grams of water a day can be measured.

Also on the same stand was a demonstration of the separation of isotopes by means of thermal diffusion. The method is used at Harwell for the isolation of rare isotopes such as ^{18}O and ^{3}He from the naturally occurring isotopic mixtures, and also for the separation of gas mixtures for analytical purposes. The gas mixture is contained between two concentric glass tubes, the gap size being fixed empirically and the inner tube heated; separation occurs by the segregation of the heavier gas near the cold surface at the lower end and lighter gas at the hot surface at the upper end of the tube.

South African Wool Grease

WOOL grease, worth about 1s. per lb, as a by-product from raw wool scouring, may become the basis of an industry worth more than £2,500,00 a year to South Africa. A process developed in the Johannesburg Laboratories of the Council for Scientific and Industrial Research makes it possible to produce £67 5s. worth of chemical products from 100 lb. of wool grease, worth £5.

This amount of wool grease will provide 45 lb. of wool grease acids, worth 6d. per lb., 35 lb. of wool grease alcohols worth 3s. 6d. per lb., and 15 lb. of cholesterol, worth 80s. per lb. Wool grease has always been split into its constituent acids and alcohols by a chemical process. South African scientists have discovered a cheaper method, using lime as an essential ingredient. This process has now been commercially patented in South Africa.

The alcohols obtained would be used in the highest-grade cosmetics and medical preparations. The acids would be used as ingredients of the special oils used in the textile industry. The cholesterol is in great demand for the production of Vitamin D and hormones.

South Africa now produces some 500,000 lb. of wool grease every year, but it is estimated that something like 4,000,000 lb. should be recoverable.

Most South African wool used to be exported in its greasy state, but increasing quantities are now being processed within the Union.

One-Year Courses

Appeal For Industrial Support

THE merit of one-year courses at the universities and the failure of industry to give them adequate support were discussed by Professor F. H. Garner, director, Department of Chemical Engineering, Birmingham University, in a recent letter to *The Times*.

In 1949 the suggestion was made by industry, through the Federation of British Industries, wrote Professor Garner, that one-year courses might with advantage be organised by the universities in order to afford to a proportion of graduates with suitable industrial experience an opportunity for further study of advanced concepts and techniques within their own specialised fields. The University Grants Committee took up this suggestion with energy, with the result that graduate courses in selected aspects of engineering science were instituted in a number of universities.

Courses at Birmingham

Typical of this development were the graduate courses established in October, 1950, in Birmingham University in the departments of mechanical engineering, chemical engineering, and metallurgy.

There was no doubt that the creation of these graduate schools represented a development of considerable importance in the field of engineering and metallurgical education in this country, and that they possessed valuable potentialities.

It was in the belief that knowledge of these courses had not yet reached those employers and directors who shaped their companies' policies that the letter had been written. The universities saw here an opportunity to serve the country, and they were providing in this instance a service which industry had particularly requested.

Ultimate success of the venture must, however, be dependent on the co-operation and support received from industry itself. Once these new courses had had time to prove their value, little difficulty was anticipated in regard to the attraction of a continued flow of students.

It was now, in the early stages, that support was particularly required, so that these new courses might develop quickly and make their final contribution to the fulfilment of an urgent need.

New Du Pont Film

Polyester Similar to 'Dacron'

DU PONT'S new synthetic film 'Mylar,' now being produced experimentally on semi-works scale in Buffalo, N.Y., is chemically similar to the company's recently announced polyester-based photographic film of superior toughness. It is being evaluated in a number of industrial fields, but it will be several years yet before it is generally available to commerce. Probable major uses for the film will be electrical insulation, film-based tapes, and in combination with other materials as laminates. Packaging and collapsible tubes may also be among its applications.

'Mylar' looks like cellophane and besides having most of the best properties of other commercial films, it also has several unique properties, say the company. Thus it is from twice to eight times as strong as other commercial films, it retains dimensions and properties over a wide range of temperature, and has intermediate electrical polarity, enabling it to store electrical energy. Also it has high dielectric strength, without excessive power loss.

Chemically, the molecule is a condensation polymer obtained from ethylene glycol and terephthalic acid, and thus is similar to 'Dacron,' the company's newest synthetic textile fibre, except that it is cast in continuous sheets instead of being spun. It sells at present at between 20s. and 30s. per lb.

Waste Disposal Allegations

A REPORT that certain oil refining firms in the Chester and Ellesmere Port areas have been seeking places in which to dump waste products from their refineries is to be further investigated by the pollution fisheries committee of the Cheshire River Board.

This decision was reached by the board at its meeting in Chester on 15 April when a letter from the Ministry of Housing and Local Government was considered which alleged that, if the information was correct, there was a danger of rivers and underground water being polluted.

It was stated that the Ministry's attention had been drawn to the matter by the Ministry of Agriculture, but the board itself did not know of any specific incidents.

Modern Trends in Process Instrumentation

By J. PROCOPI & S. D. ROSS
*(Minneapolis-Honeywell Regulator Company, Philadelphia)**

IT is difficult to summarise recent developments in process instrumentation strictly in terms of new products. It is better to study the philosophy practised by chemical and process engineers, instrumentation engineers and instrument designers and manufacturers. Through an understanding of this, it is possible to obtain a clear concept of what is really happening in process instrumentation. Some of these modern trends are:

(1) *Centralisation of Control*, with its emphasis on the elimination of the problems of (a) lags caused by long transmission distances, (b) confusion of operators who have to memorise the functions of scores of instruments, all similar in appearance, and (c) large size and cost of central control houses.

(2) *Segregation of Important Data* through scanning and monitoring.

(3) *Direct Product Quality Control* with less dependence on inferential measurements.

(4) *Recognition of Servomechanism Techniques* in the application of instruments to processes.

(5) *Incorporation of Computor Techniques* into process control.

A review of past progress in instrumentation provides a helpful background against which to view present trends. Instrumentation history reveals three distinct periods of advancement:

(1) The accounting and recording era, (2) the automatic control era, and (3) the present transition era.

As a result of the impetus supplied by World War I, mass-production techniques and continuous processing emerged early in the 1920's. Cost accounting, a necessity in mass-production, required better tools than the hand-counting methods then used. Fluid flow meters and continuous weighing equipment, which provided records 24 hours a day, became an intimate part of practically all processes.

By 1930, therefore, an estimated 14,000 American manufacturers were using industrial instruments in their plants. This period also witnessed early research into automatic control, spurred on by the ever-increasing complexity of processing technology. Even with reliable information continuously at hand, the shortcomings of manual operation began to become apparent.

By the mid-thirties, instrumentation began to be looked upon as a necessity in meeting quality and cost requirements. The number of users rose to 18,000. Technologically, industrial instrumentation entered the automatic control era, for it was found that on-off control could not handle all of the processing problems. Proportional, proportional-plus-reset, and other more sophisticated modes of control were developed to keep pace with the growing advances and complexities of processing techniques.

World War II and its feverish industrial aftermath bestowed upon the instrument industry a rôle of vital importance. Orders for instruments today come from more than 40,000 users and it is estimated that by 1954 the total will become 90,000.

Centralised Control

Returning to present-day developments, in the years that immediately followed the emergence of continuous processing, locally mounted indicating and recording controllers were employed to regulate process variables. These locally mounted instruments, however, failed to provide the automatic co-ordination that was required for the most efficient operation. Early attempts to effect closer supervision and better co-ordination took the form of locally mounted panel boards.

The next step was a grouping of these individual panel boards into one control board which was then mounted in a centrally placed control room. As processing increased in size and complexity, the number of instruments employed continued to increase until control panels became large and unwieldy. Operator training time consequently increased; perhaps the most serious problem was that of lags attendant on long transmission distances.

In order to improve overall process supervision and to lessen the confusion resulting from over-enlarged panel boards, many attempts were made years ago to effect a graphical representation of the process on

* *A shortened report of an address given before the American Institute of Chemical Engineers, Atlanta, Ga., on* 17 *March.*

the control board. Out of the period of gradual development which followed, emerged the graphic panels as we know them today.

Graphic Representation

In one type of panel, the semi-graphic, only small-dial type industrial instruments are placed in the flow diagram. Miniature recorders and controllers, as well as those of conventional size, are mounted below and alongside the diagram. Coloured symbols are used on the instruments and in the flow diagram to indicate the points of application. In contrast with this method of instrument mounting is the full graphic panel which uses miniature recorders and indicators mounted directly in the flow diagram. In this type, as in the semi-graphic panel, the use of colour is important in keeping streams identified.

Simultaneously with the growth of graphic panels has been the development of industrial instrument components that permit close-coupled control systems, thus resulting in a minimum of transfer lags. The merits of close-coupled systems have been established for processes where measurement and control lags are small. Thus, in a flow installation, a newly developed blind controller is placed adjacent to the process or on the valve yoke. In this manner, the advantages to be gained from the small measurement and control characteristic time are not cancelled out by long transmission lags, which occur when the controller is far removed from the process.

In this development the controllers are mounted on the reverse side of the panel board. This method of installation is usually employed where transfer lag is a small part of the total lags in the system, such as is usually the case in temperature control.

On the front of the board, miniature recorders and indicators are mounted in the flow diagram corresponding to the points of measurement in the process. Units, such as miniature recorders which are mounted on six inch centres, provide a continuous record of the process variables. By means of knobs and switches, the control valve air pressure loading and set point can be obtained, or an operator can switch from automatic to manual operation and back to automatic, without upsetting the process.

Many advantages result from the use of graphic panels. It is generally agreed that they reduce panel board space as well as the size and cost of a control room. In addition plant operators with little prior knowledge of the process being controlled, are appreciably helped to follow it; with the result that operator training time is greatly reduced. Delay in replacement of instruments is decreased because these miniature instruments can be quickly changed.

Among other advantages which have been claimed for graphic panels are their ease of installation and simplified starting procedure. These economies should become more apparent with improved process instrument designs and as a better understanding of the panel is obtained through increased use.

Dial and scanning systems are important characteristics of the present transition era. In a dial system, a manually supplied impulse starts a chain of actions that results in switching any desired measuring element of several hundred into a measuring circuit, so that the magnitude of a particular process variable may be recorded or indicated. In a scanner, a timed impulse replaces the manual one. Indicating type dial and scanning systems that are equipped with alarms are termed 'monitors' whereas recording types are called 'loggers.'

Dial System Designed

The Sun Oil Company recently designed a dial system. In order to check the temperature of a specific thermocouple, the operator simply had to dial three numbers. The system is arranged so that the next nine thermocouple points to the first thermocouple can be checked by simply adding one impulse at a time. A scanner-monitor-logger has also been designed in which a timed impulse, operating in conjunction with the recorder printing mechanism, starts a chain of action which automatically switches one thermocouple at a time into the measuring circuit. This switching action also energises the 'point' and 'bank' lamp on the face of the control unit. In one particular unit there are nine banks of nine points each, or a total of 81 thermocouple points. Various switches in this unit provide flexibility in operation. Any bank may be recycled or omitted, as desired. Printing can be continuous, or, by simply throwing a switch, the instrument can be made to print only when the set point is exceeded.

Another significant trend in process instrumentation is the increasing use of continuous analysers in control of product quality.

This leads to better control, improved equipment design, higher yields and quicker research made possible through faster, more accurate analyses than are possible by current sample-to-laboratory methods.

A mass spectrometer was recently installed at the Paulsboro refinery of the Socony-Vacuum Oil Company for the continuous analysis of a de-ethaniser bottoms stream. Concentration of ethane was continuously and accurately recorded during a test period of several months' duration.

Infra-red Analyses

Similarly, infra-red analysers have been used to determine the carbon dioxide content of flue gas in a fluid catalytic cracking unit and host of other applications. Continuous density recording mechanisms measure per cent conversion of monomers in butadiene - styrene co - polymerisations. Continuous testing dielectric constant meters determine the concentration of aromatics in a mixture of hydrocarbons, while continuous refractometers analyse the composition of olefines in a mixture.

The last decade has witnessed extensive engineering activity in a new approach to control problems in the process industries—servomechanism techniques.

The cutting of plant construction costs by designs taking full advantage of automatic control and the savings in operating costs need a very exacting and comprehensive preliminary study of process control by a practical method which incorporates all aspects of the problem—process, measuring element, transmitter, controller and valve. Servomechanism techniques show much promise in helping designers to do this. Perhaps the strongest point in favour of them, however, is that at present they offer the only practical solution to more complex problems, where other methods of control analysis and prediction fail.

To servomechanism engineers, the control problem involves a study of the dynamics of an entire system. This 'system-engineering' concept embodies not only a consideration of the dynamics of the process, but also of the measuring instruments and control devices. These dynamics can be expressed mathematically over their entire range of behaviour in terms of frequency response. These frequency response curves have a sound theoretical basis and are easily manipulated by those who do not wish to delve into mathematics. They are used to help select the type of controller required and to calculate controller settings required for efficient operation.

As well as the increasing activity in servomechanisms, tremendous development is taking place in computing machinery. Large electronic digital computers are becoming more important with expanding engineering knowledge. The solution to increasingly complex calculations can be reached with electronic aids, thus saving the engineer a great deal of time.

Digital computers, for example, can be used to make quickly and accurately difficult calculations required in the design of distillation towers for multi-component systems, as well as those needed in the design of unit operations such as absorption, extraction and drying.

Computers eventually may play a significant rôle in automatic control. Present-day pneumatic controllers, of course, are computors, and more specifically, analogue computers, by definition. However, as the name implies, the function or physical quantity operated on here is analogous to the original signal, and as such is related only indirectly to the actual dynamics of the process being controlled, and to quality factors in the product. As discussed earlier, servomechanism techniques supply the answer to the question of how to combine the dynamics of process and instruments. The computer, on the other hand, may be the means of bringing quality control into the same circuit. A suggestion has been made as to how this may be accomplished. Product viscosity, which is closely related to product quality, is measured and returned to the control loop. Process variables of temperatures, pressure and ratio of materials are controlled by conventional instruments. The computer is used to interpret the quality measure in the light of process dynamics, and, in turn, establishes regulation over the various process variables.

Progress Assured

Whether this combination of conventional end-point servomechanism and computer techniques will one day represent the ultimate form of process instrumentation cannot be predicted with any degree of accuracy. Nevertheless, from a study of the past progress of instrumentation, it is clear that, regardless of the ultimate end, instrumentation, aided by processing developments, will continue to progress.

Conservation of Materials

U.S. Digest of New Methods

NEW methods and machines in ceramics and product finishing of interest to the chemist are included in a digest of new developments recently issued by the Information Division of the Mutual Security Agency, London.

A discussion by several U.S. manufacturers of ceramic-coated materials with metallic base, had resulted in a number of suggestions in regard to conserving cleaning materials, conserving sulphuric acid and nickel salts, and conserving sodium cyanide

Of these, a plant-designed oil separator tank used in conjunction with the cleaner tank considerably extended the life of cleaning solutions. Often these solutions failed to function properly simply because oil scum that had accumulated at the top of the cleaning tank was redeposited on the metal during cleaning. In one plant, a modification of this arrangement was prolonging the life of cleaner tank solutions five times or more when a separate device was used for sludge remover.

Suggestions for saving sulphuric acid were:—

(a) When purchasing sulphuric acid, inspect the storage tank, all transfer pipes, and all valves and fittings in order to prevent loss of acid because of failure of these parts.

(b) When measuring acid for addition to the pickling tanks, use a vessel of earthenware or iron to catch dripping acid that might otherwise go to waste.

(c) Nickel salts could be conserved by keeping storage tanks as dry as possible, placing them on pallets off the floor. Several suggestions were also given for preventing waste of nickel salts rendered unfit for use because of the presence of iron sludge in the bath.

(d) Conserving sodium cyanide. At one plant, the use of a relatively small amount of caustic soda had reduced the amount of sodium cyanide required for neutralising solutions by approximately 50 per cent. (*Better Enamelling*—November, 1951.)

The use of electronic values to measure the chemical balance of dyes in a vat may make it scientifically impossible to produce poorly dyed fabrics, according to *Textile Aids* (December, 1951). All guesswork in the compounding and application of dyes is claimed to be eliminated by means of an electronic controller and recorder system.

Once an effective dye solution has been prepared in the laboratory and its 'reduction potential' has been recorded, the operator simply adjusts a few dyes to maintain the same condition in the dye bath. The system itself automatically compensates for any variations in the acidity or alkalinity of the water in the dye bath or of chemicals that go into the bath. It is stated that this type of control can decrease production cost, speed production, and help to ensure uniform high quality vat colour.

Differential metal plating, in which a different weight coating is applied to each side of metal containers, as a tin conservation measure, was first tried out during the last war. Now, experimenting along the same lines with tin plating, the Weirton Steel Co., Weirton, Virginia, has successfully developed five combinations of differential coated electrolytic tin plate. The savings in tin, resulting from the adoption of a differential for the grade previously used, is said to range from 16.7 per cent to 50 per cent, the amount saved varying with the weight combination used.

The process employed is the acid type similar to that commonly used in Europe. Plating is done by the halogen process and the electrolytic production-plating lines are constructed horizontally to permit the deposition of tin on one side of the strip at a time. The plating section has two tiers of 12 electrolyte cells each, or 24 cells in all. Each cell can be operated independently, as can each of the two plating tiers. (*Steel*—December, 1951).

I.C.I. (*Australia*) Issue Plan

ADDITIONAL working capital and plant extensions at Osborne, South Australia, to increased output of alkalis is planned by Imperial Chemical Industries of Australia and New Zealand.

To achieve this it is proposed to ask the public to subscribe £3,000,000 in 4½ per cent debentures which would have a 20 years' currency with an option of redemption at par after 15 years if the company wished.

A further issue of ordinary shares in the near future is being considered.

In 1950, a debenture issue was made for £3,000,000 at 4 per cent at the same time as a public issue of ordinary shares.

New Instruments & Apparatus for Research

Developments Carried Out by the DSIR

INSTRUMENTS and apparatus incorporating novel features are constantly being developed by the Department of Scientific and Industrial Research for the requirements of its own research programme. It has become customary for some outstanding developments to be shown each year at the Physical Society Exhibition. This year instruments shown at the DSIR stand were contributed by the Fuel Research Station, the Joint Fire Research Organisation, the National Physical Laboratory, and the Water Pollution Research Laboratory.

The standard all-glass apparatus based on the method of Brunauer, Emmett and Teller is unsuitable for the routine determination of surface areas. A new apparatus has therefore been designed by the Fuel Research Station for routine measurements. Constructed mainly of metal, it has a minimum of components and is simple to use.

With the exception of the Pyrex glass sample holder, the system is made of seamless silver-soldered copper tubing. Pressures are read on Budenberg diaphragm gauges. The sample is degassed in a small furnace at 300°C. with the usual diffusion and backing pump system. Cylinder nitrogen is used and is taken directly into a water-jacketed bulb through a metal high-vacuum stop-cock. A special high-vacuum piston and cylinder control valve is used between the constant volume and sample bulbs. Dead-space and sample bulb volumes are determined by using nitrogen at room temperature and calculating the contraction at the experimental temperature, thus eliminating the need for a separate measurement with helium. The low-temperature bath is liquid oxygen. This apparatus was demonstrated at the Physical Society Exhibition.

Mercury Diffusion Pump

A small mercury diffusion pump was also shown by the Fuel Research Station. A unique feature of this equipment is the use of a 'cold-finger' condenser with a concave base on to which the mercury vapour stream impinges from a small jet and tube assembly. This enables the total volume of the pump to be kept quite low, and makes the pump suitable for the collection of small gas samples up to a final pressure of several millimetres of mercury.

To obtain high concentrations of spray of comparatively uniform drop size, a hypodermic needle spray battery has been designed by the Joint Fire Research Organisation. It is based on the hypodermic method of producing drops of controllable size (W. R. Lane, *J. Sci. Inst.*, 1947, **24**, 98) and its chief feature is the method of assembly of 169 needles. The end of each needle is centred in an air hole by passing it through a slotted hypodermic sleeve which fits into a receiving nipple. The battery is used to determine the effect of drop size on the quantity of spray required to extinguish fires. The drop size of the spray may be varied by varying the air-flow past the ends of the needles, and the rate of flow of spray by varying the number of needles, or the water pressure above the needles.

Mach Number Gauge

Among the instruments shown by the National Physical Laboratory was a Mach Number Gauge, which is used by the Aerodynamics Division in the control of a high speed wind tunnel having a variable stagnation pressure. Mach number is an explicit function of the ratio of working section static pressure, P, to the stagnation pressure, H. The gauge is a manometric balance designed to give zero deflection at any pre-set value of P/H, that is, Mach number independently of variations in stagnation pressure. Two balance arms react on each other through a central pivot, the relative position of which can be varied by traversing the whole of one arm. Each arm is set initially so that the movement about its own pivot is directly proportional to the working section static or stagnation pressures respectively. In operation, the position of the moving arm is adjusted to make the effective ratio of the balance arms equal to the value of P/H for the required Mach number. The static pressure is then controlled to maintain balance.

Measurements of pressure produced by a fine tube in a reasonably steady air stream are affected by waves created by small variations of speed, which change the mean level

of liquid in the manometer. These effects are minimised in a micromanometer of small capacity, developed by the Aerodynamics Division, which consists of a horizontal glass tube of small bore containing a short column of liquid. The tube is mounted on a tilting base, and by rotating a screw thread the column can always be brought to a fixed position to balance the pressure difference applied to the ends. The meniscus of the column is observed with a microscope. One small division on the wheel measuring the inclination is equivalent to 3×10^{-6} in. of water. This gauge was demonstrated at the Exhibition.

Attracted Disc Voltmeter

The Electricity Division of the National Physical Laboratory was represented by an absolute attracted disc voltmeter for 500,000 volts. This voltmeter is designed to operate in compressed nitrogen (at 200 lb./sq. in.) up to a maximum electric stress of 100 kV (RMS) cm. Separation between the parallel plate electrodes is adjustable to any value between 0 and 6 cm. The electrostatic force acting on a disc is balanced by the electromagnetic force in a coil situated between the poles of a permanent magnet. The displacement of the moving system is indicated by a differential capacitor, the middle plate of which is mounted on the spindle to which the disc and coil are also attached. The relation between the current in the coil and the force acting on it can be determined by balancing a known weight which can be lifted on or off the moving system by a solenoid-operated mechanism.

Several developments in ultrasonics were shown by the Physics Division. By using barium titanate as the piezo-electric material, it is possible, because of its lower impedance, to generate much higher powers than from quartz for a given supply voltage. Shorter time of paralysis and better bandwidth can also be obtained. An application of this method to ultrasonic flaw detection is illustrated by common transmitter-receiver probes for 1, 2½ and 5 Mc/s.

Another interesting development in flaw detection is a steerable beam device for 2½ Mc/s. Making use of a variable angle wedge, this device permits scanning from a fixed site over an angle of ±45°C. Also on view was Flaw Detection Standard Type 1, this being a steel block with accurately drilled holes, which permits assessment of the behaviour of flaw detectors.

The Physics Division was also represented by a tenuous wide-frequency-band magnetostriction transducer. A long fine nickel tube (or a wire locally coated with nickel) is threaded through a short coil and polarised. One end transmits or receives vibrations and the other is damped to eliminate reflections. Longitudinal and torsional resonance test methods using this traducer were shown; they are capable of an accuracy of measurement of 0.03 per cent in resonance frequency.

Graphs showed the results for alloys of copper with metals of the sub-group and of aluminium alloyed with zinc, copper and magnesium.

A flashing neon lamp device has been used by the Water Pollution Research Laboratory to give a continuous indication of the conductivity of 'de-ionised' water leaving an exchange column (G. Knowles, R. Briggs and L. J. Scragg, *Chem. and Ind.*, 1951, **33**, 700). It might also be used for monitoring low-conductivity waters such as boiler-feed, returned condensate, and the outputs of stills. Robust electrodes placed in the water control rate of flashing of a neon lamp, a water of higher conductivity causing a higher rate of flashing. A second neon lamp flashes at a constant rate corresponding to a chosen conductivity. The range of conductivities covered can be altered by changing the electrode sizes and/or spacing. The instrument is inexpensive and contains no valves; its accuracy is not affected by voltage or mains frequency variations.

New DSIR Instruments

There are, of course, a number of new DSIR instruments which were not seen at this year's Physical Society Exhibition. For example, the well-known Twyman-Green interferometer of Hilger & Watts Ltd., has been equipped with a compact attachment which, with monochromator and a camera, makes possible the complete testing of the optical performance of all types of microscope objectives. This attachment has been developed by the Light Division of the National Physical Laboratory. The objective is carried on a nodal slide, so that measurements of focal length can be made and axial and off-axis performance can be studied. An adjustable negative lens corrects for 'tube-length'. The spherical mirror against which the wavefront is compared is interchangeable; it is carried on a kinematic wire suspension which permits

measurable independent displacements of the mirror in three co-ordinate directions, these being repeatable to less than 0.1 microns.

In the photometric rating of lenses it has been the practice to provide the iris diaphragm control with a scale showing the f-number as an aid in calculating exposure times; this depends on equivalent focal length and effective aperture, and takes no account of light losses due to reflection at or absorption by the optical elements. A photometric index, termed the t-number, provides a more accurate assessment of the relative illumination in the lens focal plane. Moreover, with lenses of conventional form viewing an extended surface of uniform luminance, the illumination in the image plane is not uniform.

Two methods of measuring t-numbers and field illumination have been developed by the Light Division. In the first, to obtain its t-number the lens is mounted in front of a collimator and the light flux transmitted is compared with that passing through a circular aperture. The field illumination is obtained by rotating the lens about an axis in the plane of its entrance pupil.

In the second method, a surface of uniform luminance is arranged in the plane of the entrance pupil and the flux then passing through a small circular aperture mounted in the lens focal plane is compared with that transmitted when the lens is replaced by a circular aperture. To measude field illumination the small aperture is moved across the focal plane.

Precision Spherometer

A precision spherometer developed by the Light Division is based on that described by Guild (*Opt. Sec. Trans.*, 1918, **19**, 103) and is suitable for the measurement of the curvature of spherical surfaces of transparent lenses. The ball-ended central gauging tip is set just out of contact with the lens with the aid of the Newton Rings system formed between the surfaces and viewed in the microscope above. Precision is attained by improvements in the three-ball lens support (due to W. H. Lee, *see* L. C. Martin 'Optical Measuring Instruments,' 1924), and by the use of a precision non-rotating micrometer head equipped with a slow motion drive. The instrument is arranged so that the curvature of very thick or prismatic lenses can be measured, with a limit of accuracy of 0.002 metres^{-1}, depending on the size of the lens; this corresponds to an accuracy of 0.02 per cent for a surface with a radius of curvature of 100 mm.

Special discharge lamps now available for the optical interferometry of reference end-standards employ a pure isotope, of either mercury ($^{198}_{80}$ Hg) or krypton ($^{86}_{36}$ Kr), as the source of optical emission. The simple monochromatic radiations emitted by these lamps permit interferometry to be directly applied to much greater lengths than is possible with sources of the natural elements.

Wavelengths Compared

In an apparatus developed by the Metrology Division a water-cooled mercury-198/argon lamp, of the electrodeless type excited with oscillations at 100 Mc/s, is the source of light. Reference end-standards up to 12 in. (30 cm.) length are measured in a Kosters interferometer, using the two yellow, the green and the blue lines of mercury-198. The wavelengths of these lines have been compared with the wavelength of the cadmium red line, which is accurately known in terms of the yard and the metre (Proc. Roy. Soc. A., 1951, **209**, 132). Results obtained with 12 in. standards agree to $\pm 1 \times 10^{-6}$ in. ($\pm$ 0.025) with the values established by the normal metrological procedures from the primary yard line standard.

An experimental microwave interferometer has been used by the Metrology Division to derive a new value for the velocity of electromagnetic waves. The result obtained for the velocity in a vacuum is Co = 299, 792.6 $\pm$ 0.7 km/s. In essentials the apparatus is equivalent to the optical Michelson interferometer, with the fixed arm located in a waveguide, and the variable arm in the open air. A hybrid junction ('magic-T') acts as the beam divider. The variable arm consists of a transmitting horn and distant movable reflector which returns the energy to the horn and into a detecting device, where interference take place with the energy returned from the 'fixed' arm.

Source is a stabilised klystron, oscillating at a frequency of 24,005 Mc/c (= 1.25 cm.). By means of end-gauges of known length the reflector is displaced through an integral number of half wavelengths (detector minims). Thus, subject to a diffraction correction, the wavelength is found. Velocity is obtained from the product of wavelength and frequency. The frequency is measured by comparing the microwave oscillator with a high

harmonic of a standard quartz oscillator.

A comparator, designed and made at the NPL for the continuous measurement of the diameter of fine wire, operates upon a pneumatic principle. The wire is drawn by motor between a fixed flat anvil and a radiused anvil mounted on a gravity-controlled lever. Variations in wire diameter raise or lower the radiused anvil, and this movement alters the escapement of air from a fixed jet. The resulting pressure variations are pneumatically amplified and transmitted to a recorder. Overall magnification is 5,000 times. The apparatus is not suitable for application to the production line, but may be usually employed in the laboratory for detailed examination of local variations in wire diameter.

Small Angle Generator

A small angle generator, designed and constructed at the NPL, comprises a sine bar which is pivoted at one end and may be raised or lowered hydraulically on to appropriate slip gauges at the other end. When applied to the calibration of auto collimators a reflecting face is mounted on the bar above the pivot point in the optical path of the instrument under test. The range of measurement is of the order of ± 20 minutes of arc at an accuracy of ± 0.5 second. The design of this machine is such that it may be adapted to other applications requiring the generation of small angles to a high precision.

A cavity resonator is used at the NPL in the latest determination of the velocity of light. Multiple reflections of a radio wave having a frequency near 9,000 Mc/s produce a standing wave in the resonator. The length of the resonator is varied by means of a piston and the wave length is obtained from the difference between successive resonant lengths. In this way certain end-effects are eliminated and by using two different frequencies the errors due to imperfections in the surface are also greatly reduced. The repetition accuracy of the experiment is ± 0.5 Km/s and the final result is 299, 792.5 ± 1 Km/s.

A campaign being organised by dairymen for the salvage of used aluminium foil milk-bottle caps is being supported by the Ministry of Food. Some 5,000 tons of aluminium foil are used every year.

Leather Chemists Meet

Paper on Boundary Tensions Read

A MEETING of the Northampton Group of the Society of Leather Trades' Chemists held at the College of Technology, Northampton, on 27 March, heard Dr. A. F. H. Ward, M.A., give a paper on 'Recent Investigations and Applications of the Boundary Tensions of Solutions.'

The particular aspect of boundary tensions which was dealt with was the variation, with time, of surface and interfacial tensions for certain solutions. When a surface or interface is freshly formed, it may not immediately acquire the equilibrium value of the boundary tension. This may require a time interval varying from a fraction of a second to several hours.

The speaker described the historical development of work on the time-effect for surface tensions, and discussed the experimental techniques available for following the changes in boundary tensions. It was desirable (he said) that the measurement of the tension should not involve the destruction of the surface. The 'sessile bubble' and 'pendant drop' methods were especially suitable. Here the shape of a hanging drop was determined by its surface tension and density only, so that suitable measurements from a photograph, or projected image, of the drop enabled the tension to be obtained over a range of time. For very small surface ages, the variation of surface tension could be found from measurements of surface potential or of vibrations at different positions along a jet of liquid.

Recent Work Described

Dr. Ward gave an account of recent work on this subject in the Physical Chemical Laboratories at the Faculty of Technology of Manchester University. Here, interfacial tensions between water and solutions of higher fatty acids in hexane had been studied. It had been shown that the speed of diffusion of molecules to the interface could not be the controlling factor in the time-effect. The kinetics of the process had been investigated and rate constants obtained for both adsorption and desorption of the molecules at the interface. This had led to the conclusion that there was a 'barrier' which interfered with adsorption and gave a low probability that a molecule would be adsorbed after a collision with the surface.

Records of X-Ray Diffraction from Powders

The 'Finger-prints' of Crystalline Materials

by W. A. WOOSTER, Sc.D., M.A., F.Inst.P.
Lecturer in the Department of Mineralogy and Petrology, Cambridge

USE of crystalline powders to give X-ray diffraction photographs was first made in 1916. The method was developed independently by Debye and Scherrer in Switzerland and, a year later, by Hull in the U.S.A. These authors allowed a fine beam of X-rays to fall on a cylindrical rod of powder and received the reflected X-rays on a photographic plate or film. With several variants this method has continued until the present time. The film may be flat or cylindrical, it may receive the X-rays reflected in a forwards or a backwards direction. The powder may be prepared from large single crystals by grinding or filing, or it may simply be a piece of polycrystalline material which has been shaped to fit the camera.

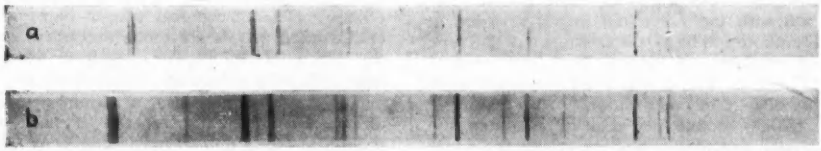
Some years after the original photographs were taken a so-called 'focusing' camera was introduced. The special virtue of this type of camera was that it considerably reduced the length of exposure required. The powder was distributed over an area of a few square centimetres on the inner cylindrical surface of the camera and the X-rays were admitted through a fine slit in this same cylinder. The X-rays reflected from all parts of the powder were in this way caused to converge on a line on the film which was also mounted in the same cylinder as the powder. The resulting photograph differed little in general appearance from the Debye-Scherrer type of pattern, an example of which is shown in Fig. 1. The disadvantage of this camera was that only a restricted range of diffraction angles could be studied on any one instrument and several cameras were necessary to obtain the same information as that given by the Debye-Scherrer camera.

Early cameras were, by modern standards, of small size having a diameter not usually greater than 6 cm. Since that time cameras of many sizes ranging up to a diameter of 100 cm. have been used, though it is not common to use a diameter greater than 19 cm. The larger the camera the greater the separation of the powder lines but the longer the exposure required. A 9 cm. diameter powder camera is shown in Fig. 2.

Applications of the powder method are so numerous that it is not possible to do more than mention some of them very briefly. The simplest application might be described as the taking of 'finger-prints' of the crystal structure. On a powder photograph of a given substance in the same crystalline state there are lines which always have the same relative positions and the same relative intensities.

Such a pattern therefore forms a ready means of identifying the substance. The pattern varies with the size of the camera and with the kind of X-ray tube used but, using a generally acceptable camera diameter and a convenient type of X-ray tube, such as one having a copper anticathode, it is possible to construct an index of powder photographs.

If the powder patterns of all known crystalline substances were available and were arranged in some regular sequence, it would be possible to compare the powder photograph of any unknown substance with a pattern in the index and thus identify the unknown material. Unfortunately, only a fraction of all crystalline substances have been classified in this way and there are important difficulties in arranging the patterns in a way which makes it easy to compare an



[Courtesy, Unicam Instruments, (Cambridge) Ltd.

Fig. 1. Powder photographs of platinum wire using Cu K_α and Cu K_β radiations in 19 cm. high temperature camera (a) at 900°C. (b) at 20°C.

unknown with the known patterns. However, even with these limitations the indexes which have been made, notably the ASTM index, are extremely useful, especially to those who have had some training in dealing with knotty points.

Use of Powder Method

There can be few industries which employ raw materials of any kind which would not find some applications for the powder method of controlling the purity or quality of their starting material. In the construction of certain furnaces, for instance, it has happened that a very small quantity of one of the forms of silicon dioxide, present in the furnace lining, caused the collapse of the furnace at high temperatures. It is very difficult by chemical analysis to determine the cause of such a failure of the brick lining but by the X-ray method using a simple powder pattern it is possible to identify the unwanted constituent before the brick is put into service.

In the manufacture of chemicals for analytical work or for pharmaceutical preparations great purity may be essential. The powder method is well suited for such testing of purity because the presence of extra lines on the photograph is easily seen and only a few milligrams of material is necessary for the test.

There are many applications of the powder method to metallurgy. Alloys of two, three or more metals usually crystallise in different forms according to the relative proportions of the various elements in the melt. The alloys of silver with cadmium give a good example of the type of information which can be obtained. Pure silver has a face-centred cubic structure and the pattern of this consists of relatively few lines. The alloys of silver with up to some 40 atomic per cent of cadmium are of the same atomic arrangement except that the whole structure is expanded uniformly to admit the cadmium in place of the silver. Over this range of composition the cadmium forms a solid solution with the silver and this is revealed in the photographs by the constancy of the type of pattern, combined with the gradual change in the position of the lines with the change of composition.

At 50 atomic per cent of cadmium the crystal structure is also cubic but the silver atoms are at the corners of the cubic unit cell and the cadmium atoms at the body-centre of the cube. This change of atomic arrangement is revealed by the change of pattern in the powder photograph. As the concentration of cadmium in the alloy is increased, two other atomic arrangements are obtained before the hexagonal arrangement of cadmium itself is reached. In this series of alloys of cadmium and silver there are thus five distinct types of pattern both in the atomic arrangement and also on the corresponding powder photographs.

Much of this information can also be obtained by the methods of metallurgy but the X-ray method operates on very small quantities and at any temperature. One of the recent developments (referred to later), is the use of powder cameras for high temperature investigations, and it is also possible to use liquid air or other coolants to reduce the temperature if necessary.

Results which can be obtained on alloys thus include (a) the compositions at which certain phases occur, (b) the presence of solid solution of the various phases in one another, (c) the study of intermetallic compounds at high temperatures which may decompose on cooling.

Orientation of Crystals

Another metallurgical application concerns the study of the orientation of the crystals composing a wire or rolled sheet. This orientation is brought about by the mechanical process involved in making the wire or sheet and it affects the powder photograph in the following way. When there is no preferred orientation among the crystals making up the powder specimen, the lines are equally dense all round the direction of the incident beam.

For this work the X-rays are frequently received on a flat plate or film and in this case the reflected rays form circles round the point where the central beam passes through. For a simple powder the circles are uniform but if there is preferred orientation present then they are darker in some places than others. The mechanical properties of all cold-worked metals are much dependent on the degree of drawing or rolling to which they have been subjected. Sometimes, as in making metallic pressings, a certain degree of preferred orientation of the crystals is necessary for the proper shape to be obtained after pressing. The presence of preferred orientation due to mechanical

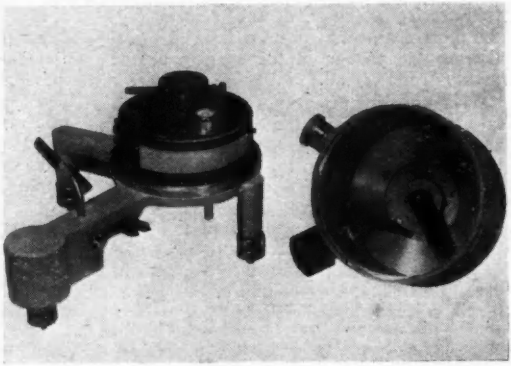


Fig. 2. — 9 cm. diameter powder camera (Unicam Instruments [Cambridge] Ltd.)

treatment may, however, detract from the usefulness of the material.

The X-ray powder photographs give a good measure of the degree of the preferred orientation and hence a reliable guide in many instances to the subsequent behaviour of the material. An application of this method to the study of the orientation of the crystals in rocks is becoming of increasing importance in mining. The permissible thickness of walls and roofs in mine galleries is sometimes dependent on the orientation of certain crystalline constituents of the country rock. The petrologist may be able to determine this orientation by optical means, but even when this is not possible X-rays can be used to find the extent to which crystals of any particular sort are lying in a given direction.

Powder patterns can also be used to study fibres of cotton, silk, wool, hair, muscle, tendon and other biological products such as horn, quill and shells. Although these materials are not fully crystalline like the metals or inorganic salts, they nevertheless have enough regularity in their atomic arrangement to give characteristic patterns. These powder photographs may be used to identify the place of origin of certain raw materials, since fibres of a given material show differences according to the region of the world from which they have come.

Artificial fibres such as rayon, synthetic wool and nylon give patterns which are related to their mechanical strength. The quality of the final product is often dependent on the treatment at some critical part of the process and by taking powder photographs just as the material goes through that part of the process it is sometimes possible to control the manufacture with greater precision.

At the end of this series of largely qualitative uses of the powder photograph is the application to glasses. These materials are not crystalline at all, except in so far as the arrangement of the atoms about any given atom does not vary greatly from one region to another. Thus, for instance, the silicon atoms are always surrounded by four oxygen atoms which lie at the corners of a tetrahedron with the silicon atom at the centre. The sodium or other ions in the glass also have a more or less definite environment and this degree of regularity is enough to give rise to broad rings on the photograph. These rings are not due to the same regularity as the lines on an ordinary photograph, but are associated with particular interatomic distances rather than with distances between lattice planes. The information which can be obtained serves to show whether the glass is the same as a standard piece or whether, due to impurities (the presence of which may be shown by extra rings), or due to the heat treatment, the product is in any way different from the standard.

There are two applications of powder photographs which are different from those already described in that the position of the lines is measured accurately and the general character of the pattern is unimportant for the purpose in hand. When the X-rays are reflected almost backwards from the specimen to the X-ray tube, the direction of reflection is very sensitive to any changes in the distance apart of the reflecting atomic planes. The closer the reflected X-rays are

to retracing the path of the incident rays the more sensitive is this variation in direction to the change in the spacing of the planes in the crystal.

This property of the powder photograph is made use of in the high-temperature cameras. Photographs are taken at two temperatures and from the movement of the lines the thermal expansion coefficient can be derived. Such a pair of photographs is shown in Fig. 1. The same property of the 'nearly-backwards' reflections is made use of to study the strains present in a specimen, usually of metal, after casting or being subjected to steady stress.

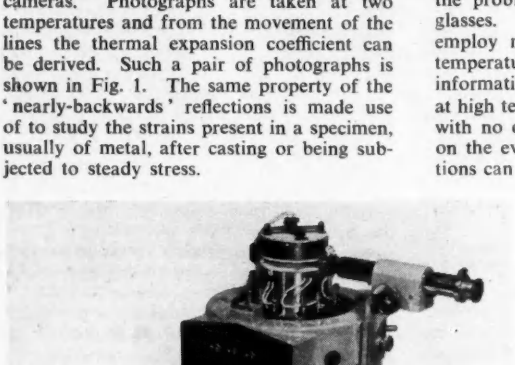


Fig. 3.— High temperature 19 cm. powder camera with evacuating chamber removed and camera assembled (Unicam Instruments [Cambridge] Ltd.)

Strain in the girders of a bridge can thus be measured on the bridge itself from the displacement of the powder lines from their unstrained positions. For this purpose it is, of course, necessary to have a portable X-ray equipment. Forgings and castings have been very much studied in various industries by this method. It may not be easy to deduce from the measured strain what is the magnitude of the stress acting on the crystals. However, experience can indicate when a given strain in any part of a steel bridge is likely to cause failure of that part and, similarly, a casting can be rejected or accepted on the basis of the magnitude of the internal strains revealed in the powder photographs.

High-temperature cameras have been used for some years for temperatures up to 1,000°C., but the range has recently been extended to 1,500°C. In principle there is no limit to the temperature to which the crystal may be raised provided that the X-rays have an unobstructed path and provided the crystal can be mounted in such a way that it does not sag on its support at the high temperature. Many metallurgical problems can be dealt with in the temperature range 0-1,500°C. as also may many of the problems concerned with ceramics and glasses. As it is not usually possible to employ microscopic techniques at elevated temperatures the X-ray method can provide information about phases which occur only at high temperatures in a way that is possible with no other method. Methods depending on the evolution of heat during transformations can indicate a change of phase, but the X-ray photographs are much richer in the information they provide about the actual atomic arrangements. In Fig. 3 there is shown one form of high temperature camera. On the left may be seen the film holder, in the centre the furnace, on the axis of which the specimen is located, and on the right the evacuated chamber which surrounds the furnace.

Another modern development involves the focusing camera. This development would probably not have occurred but for another invention, namely, the curved crystal monochromator. A plane crystal does not usually reflect an X-ray beam with a strength of more than 10 per cent of the strength of the incident beam. However, such radiation as is reflected is strictly monochromatic if the crystal is of good quality, and it is also contained within a parallel beam. When a curved crystal is used in place of a plane one the intensity is increased several times though the beam is no longer strictly parallel.

Roughly speaking, the increase in intensity is proportional to the increase in the divergence of the beam.

This divergence of the beam can be utilised in a focusing camera as indicated in Fig. 4. The beam is arranged to converge, after scattering at the powder, on a line on the film. The pattern so produced is similar to those produced in the earliest focusing cameras except that the lines are sharper and the background is much freer from extraneous fogging. This combination of curved crystal monochromator and focusing camera is of special value when it is necessary to investigate faint lines which may be part of the normal pattern or may be produced as extra lines due to the partial separation of a new phase from the original matrix of crystals. The study of the so-called 'superlattices' is an example of the value of this technique. The faint lines which appear as the superlattice separates out are difficult to observe when the background fogging is considerable, but with monochromatic radiation this trouble is almost entirely eliminated.

The last development we shall consider is a return to an earlier technique occasioned by the introduction of the Geiger counter. Most of the early study of the structure of crystals, done in this country by the Braggs, was carried out with an ionisation spectrometer. This instrument received the reflected X-rays from a crystal in a brass cylinder filled with an absorbing gas. The X-rays ionised the gas and this in turn gave rise to an electric current between a central electrode and the walls of the cylinder. This current, of the order of 10^{-14} amp., was detected and measured by the rate at which the liberated charge caused the leaves of a gold-leaf electroscope to collapse.

Although the sensitivity of the instrument was improved by the substitution of various forms of electrometer for the gold-leaf electroscope it remained, until recent times, too insensitive for the general study of powders. This situation was radically altered by the introduction of a Geiger counter suitable for X-rays. This instrument is similar in construction to the ionisation chamber but the potential to which the central electrode is raised is usually between 1,000 and 2,000 volts, and is such that the passage of one quantum of X-rays into the counter will cause a great number of ions to be produced by the acceleration of the primary ions in the strong electric field.

Subject to certain qualifications there is produced in the Geiger counter, one pulse per absorbed quantum of X-rays, and, therefore, no greater sensitivity can be expected from any subsequent detector. The pulse produced by each X-ray is amplified by a standard electronic amplifier and registered on a scaler or, if the beam is intense, the output of the amplifier may be used to operate a counting-rate meter, which gives a deflection proportional to the strength of the reflected beam. In addition, the output current may be made to operate a pen-recorder and trace a curve showing the intensity of reflection as a function of the angle at which the counter is set with respect to the incident beam.

For many purposes the Geiger counter is almost certain to displace the powder photograph. Its operation is practically instantaneous so that if the powder specimen is placed on the spectrometer in the correct position the counter will at once record if there is a reflection occurring in a predetermined direction. In any process where time is important or where an impurity is liable to occur at a certain stage and it is important to know when that has happened, the

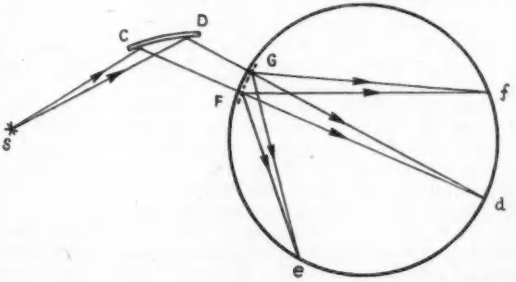


Fig. 4.—Diagram showing use of curved crystal monochromator and focusing camera

S—Source of X-rays
CD—Curved crystal focusing camera at d
FG—Powder mounted on circumference of cylindrical camera
e, f} Focused powder in lines

counter has a great advantage over the photograph. The X-ray exposure required for a photograph is likely to be at least a few minutes and another few minutes are required for processing.

Another important advantage of the counter is the quantitative character of the measurement. The whole electronic system including the counter can be made to give an indication on a meter which is proportional to the total intensity of reflection from a particular set of atomic planes. The same information can be obtained from a photograph, but it requires careful work with a microphotometer to analyse the exact distribution of intensity over the line corresponding to the particular reflection. The disadvantage of the counter is that more experience is required to use it to full advantage, and the cost of the electronic equipment is additional to that of the goniometer, which approximately doubles the cost of the instrument.

Looking to the future, it seems probable that for a long time yet the powder photograph will continue to provide the 'fingerprints' of crystalline materials and where speed is not essential or the whole pattern is required, a photograph will still be taken. On the other hand counters are more likely to be used where a rapid indication of the presence of some particular constituent is required or where a quantitative measurement of the intensity of reflection is to be employed.

Bowen Plastics Prize Fund

PRIZES of value up to £150 with a maximum of three prizes for award in July, 1953, are to be offered by the council of the British Plastics Federation, as administrators of the Bowen (Cables and Plastics) Prize Fund.

Awards will be made for papers on original investigation in engineering and/or physical problems relating to compression, transfer or injection moulding. Such contributions may, if desired, be read before the Plastics Institute or its branches or the Plastics and Polymer Group of the Society of Chemical Industry, or the Convention held in connection with the British Plastics Exhibition in June, 1953, or be submitted direct by an author. In the latter case, if a paper has not already been published and qualified for an award, it should be published in a suitable journal in agreement with the council of the British Plastics Federation.

Right to withhold the award of any prize or prizes if the papers submitted should not be deemed to be of sufficiently high standard will be reserved by the council.

Papers may be submitted direct to the council of the British Plastics Federation by the authors or with their concurrence through the responsible councils or committees of the organisations concerned.

A letter signed by a responsible official representing employers, giving permission for the author to submit the contribution should accompany each paper.

Contributions should be submitted to the general manager of the British Plastics Federation, 47/48 Piccadilly, London, W.1, not later than Friday, 31 July, 1953.

Sintered Disk Filter

A NEW British Standard (B.S. 1752: 1952) for sintered disk filters for laboratory use has now been prepared. Its two main objects are to define a filter that will give satisfactory performance for general use; and to specify requirements which can be satisfied in the normal course of manufacture, and which will therefore not add appreciably to the cost of the article.

The standard specifies pore size and permeability requirements for disk-type filters made of materials such as sintered glass, sintered silica, unglazed ceramics, sintered metals and platinum sponge. (Diatomaceous and siliceous earth filters, and filter candles, have been excluded).

Eight grades of filter of maximum pore size up to 500 microns are defined, and a method for determining acceptable uniformity of pore size for each grade is included. It also assesses permeability in terms of air flow, rather than water flow, as being more readily reproducible, but includes calculated equivalents for water filtration rate for information.

Apparatus for the tests has not been specified, as manufacturers and users will normally design their own to suit their particular requirements, but diagrams of suitable types are included for convenience.

Copies may be obtained from the British Standards Institution, Sales Branch, 24 Victoria Street, London, S.W.1 (2s. post paid).

Improving Laboratory Equipment

Commercial Application of New Techniques

CLOSE collaboration with all the main fields of research is enabling manufacturers of scientific instruments and laboratory equipment to keep pace with the rapid tempo of post-war progress. From the precise and powerful tools developed for purposes of research commercial firms are producing 'utility' models, thus enabling laboratory workers to use the latest techniques and improving the scope and efficiency of established methods.

Among the most interesting instruments at present being developed is one known as the 'flying spot microscope', which has not yet reached the commercial stage. Hitherto little of the information obtained with microscopes has been quantitative, most observers having been content simply to regard the image or to photograph it. The construction of a microscope based on a combination of optical and electronic techniques was announced early last year by J. Z. Young and F. Roberts, Department of Anatomy, University College, London[1]. This work was made possible by a grant from the Nuffield Foundation.

The method adopted depends on the well-known technique of flying-spot scanning by two cathode-ray tube rasters locked together. In front of the eyepiece of a microscope is placed a tube providing a televising raster of high brilliance and very short-time constant. The microscope objective thus produces a minute spot of light that scans the preparation to be examined. The amount of light transmitted is determined by the density of the specimen and is picked up by a multiplier photocell. The output of this is used for modulating the raster on a second cathode-ray tube of projection type.

Flying-Spot Microscope

It is claimed that the flying-spot microscope provides all the facilities of conventional microscopy with important additional advantages, among which are the following: (1) A projection display some 3 ft. square and of brightness several foot-lamberts can be obtained. (2) Since the size of scanning raster can be continuously varied, there is less need for changing of objectives; (3) the brightness of the image is readily controlled; (4) since the contrast is determined by the amplifier gain as well as by the density distribution, it can be made greater or less than in the original specimen. (5) It should be possible to produce visible displays, with incident radiation of a wavelength of at least from 2,000 Å to 10,000 Å. (6) The quantum efficiency of the photocell is greater than that of the photographic plate by at least 100 : 1 at 2,650 Å, making it proportionally easier to avoid producing alterations in living specimens. (7) Since only one resolvable region is illuminated at a time, resolution should be substantially greater with the flying-spot than with the conventional microscope.

Quantitative Analysis Possibility

Perhaps most important of all is the possibility of quantitative analysis. The output of the photocell has a voltage-time distribution known as a time series, and can therefore be analysed by well-known techniques to give histograms and spectrograms of the specimens. Particles could probably be counted and sized at a rate of a million per second.

The first model built suggested that these advantages could be realised, and further development is being undertaken.

Another application of television which is being extensively used in the laboratory—for example, to observe spark phenomena—is the variable magnification system known as the 'zoom' lens. This equipment was recently made commercially in Britain for the first time.

A scientific curiosity which is beginning to find commercial applicatons is the Hilsch or vortex tube for producing hot and cold air. During the war Professor Hilsch demonstrated that a jet of air to which a spiral motion had been imparted could be separated into two streams, one heated by compression and the other cooled by expansion. A simplified form of Hilsch's device has been described by M. P. Blaber[2]. It will produce a stream of hot air and a stream of cold air (maximum temperature 88°C., minimum temperature −20°C.) from a source of compressed air at room temperature.

Vortex tubes for experimental purposes have been made by a number of research

organisations, including the British Scientific Instrument Research Association, in order to explore the possibilities which seem to be presented by this impressive range of temperature differences. Existing or suggested applications are for cabin and accessory cooling in jet aircraft and as a thermometer for measuring cloud temperatures.

Radioactive Substances Usage

Use of radioactive substances in the laboratory continues to increase, an important development being the introduction of beta-ray thickness gauges. Alpha- and gamma-rays are also used for thickness measurement, but to a much more limited extent. The measurement of thickness by the absorption of radiation requires that the change in the radiation transmitted through an absorbing sample, placed between the source and detector, be interpreted unambiguously as being due to some certain thickness of absorber.

Since the absorption of beta-radiation depends principally on the density of the sample, and not on the nature of the sample material, beta-radiation is particularly suitable for thickness measurements. With an absorption method for measuring thickness, no contact is required with the material being measured. The maximum thickness which can be measured with beta-radiation is determined by the range of the beta-rays in the absorber.

Industrial models have been developed, which provide a convenient means for measuring the weight per unit area or thickness of materials such as paper, board, plastic sheet, metal foil, and so on, during the manufacturing process or in the course of subsequent inspection. The instrument is also applicable to the textile industry for the continuous gauging of laps, cardings or slivers. When isotopes emitting more penetrating beta-rays become available, the range of the gauge will be extended to measure heavier materials.

Techniques based on ultra-high frequencies continue to provide research workers with new and valuable tools. At the National Physical Laboratory the elastic properties of iron are being determined at varying temperatures by ultrasonic means. When vibrations caused ultrasonically are passed through a metal, they are scattered by the individual crystals of which the metal is composed, and in this way it is possible to learn something of the grain size of the metal.

This application of ultrasonics provides a non-destructive method of assessing one of the factors influencing the ultimate tensile strength of metals. Ultrasonics are being used commercially for joining pieces of metal such as aluminium, mechanical vibrations induced by means of a specially constructed soldering iron being used to break down the protective film of oxide on the surface. Ultrasonic flaw detectors for non-destructive testing are finding a widening field of applications, both in the laboratory and in commercial production.

Much work on interference filters has been carried out in Britain by Dr. K. M. Greenland, of the British Scientific Instrument Research Association. Great progress has been made in the development of filters which are at once image-forming and highly selective; that is, which transmit or reflect very narrow wavebands. The Fabry-Perot etalon or interferometer is essentially a spectroscope of high resolving power (of the order 10^6) and it is to this device that recent investigators have turned.

The basic Fabry-Perot interference filter is quite satisfactory for pass-band widths of 150Å. For width of 60Å, a more complex filter using a multilayer technique is necessary; the two silver layers of the basic Fabry-Perot must be replaced by a mixture of silver layers and dielectric layers. For width of 6Å, workers have turned either to Lyot's polarisation interference filter (1933) or to the less complex Turner frustrated total reflection filter (1947). The latter filter uses the principle of the penetration into the second medium which occurs when light is incident on a surface at an angle greater than the angle of total internal reflection.

The Turner Filter

In the Turner filter a prism hypotenuse is covered with a low index layer followed by one of high index—the surface of the low index layer constitutes a semi-transparent reflector with no absorption loss. To complete the filter another low index layer is added and followed by another prism identical to the first. The advantages of this form are (1) the filter is suitable for ultra-violet or infra-red transmission if the materials used are transparent for these radiations; (2) the filter gives two peak transmission due to

polarisation perpendicular and parallel to the plane of incidence; (3) filters with a birefringent layer have band widths as narrow as 10Å and transmissions of 70 to 80 per cent[3]. Now that the technique has been established, interference filters are beginning to be used commercially. It is believed that there is a big future for them in the laboratory[3].

Temperature Indicating Compounds

As a convenient means of obtaining a quick indication of the temperature at a given point, or the distribution of heat over a certain area, temperature indicating compounds are finding an increasing range of applications. They are of two types, namely paints containing a pigment which is formulated to change colour at a definite temperature, and chemical compounds which melt sharply at a predetermined temperature.

While it is invariably necessary in research work to determine the exact temperatures by point-to-point measurements, these indicators have been found extremely useful as an additional check on pyrometers, and so on. They have also enabled workers in many laboratories to ascertain temperatures hitherto unobtainable because of position or movement, or because the object under test could not be seen.

Another interesting development is the advent of photosensitive glass which, upon exposure to ultra-violet light, undergoes a change such that a permanent photographic image can be developed within the glass by subsequent heat treatment. The particles forming the image are dispersed throughout the thickness of the glass, producing the effect of depth and thereby giving a third dimension perspective. Photosensitive glass thus provides a photographic medium having all the attributes of ordinary glass, and is both chemically and physically stable. It was developed in the U.S.A. and has been patented.

A vast amount of research is still going on in the field of D.C. amplifiers and rapid strides continue to be made in the application of electronic principles in laboratories and production centres. Equipment of recent development was believed to represent the first application of electronic control by means of photo-electric cells to the gauging of liquids. The sensitivity of this method for positively measuring fluid volumes is indicated by the fact that it will gauge from one-half to 25 c.c. with an accuracy of a fraction of one per cent. Automatic feed by the master control unit gives accurately regulative dispensing at a high speed.

Considerable attention is being devoted to hygrometry, great interest being taken in any literature relating to this subject. It may be concluded, therefore, that existing methods are not regarded as entirely satisfactory.

Now that shortages are becoming increasingly severe, the British Scientific Instrument Research Association is receiving many inquiries regarding the properties of materials capable of being used as substitutes in the production of laboratory equipment, particular interest being taken in the use of plastics as replacements for metals. Polyethylene is being used extensively for laboratory ware such as bottles, flasks, etc. It has the advantages of being flexible and unbreakable and appears to be making very rapid headway. Increased utilisation of plastics in the polarising field is also evident. The polyvinyl alcohols in various forms are finding many useful applications. As traditional materials become still more scarce, the tendency towards substitution or replacement will doubtless be still further accentuated.

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Trying to Eliminate Catalyst

AUTOMOBILE antifreezes and other consumer products have more than tripled the pre-war demand for ethylene glycol, M. D. Straube, of Stanolind Oil and Gas Company, and Fred Kurata, of the University of Kansas, told the American Institute of Chemical Engineers, at its recent national meeting at Atlanta.

Straube and Kurata have been studying the possibility of eliminating the catalyst used in the present-day process and carrying out the reaction in the vapour phase. Theirs are the first data on this possibility, they told Institute members, and, while they leave much to be desired, these data give some basis for engineering evaluation. Actually, the modified process seems inferior to the present catalysed liquid-phase process both from the standpoint of plant safety and yield of product, they said.

Pest Control Products

British Standard to Assist Identification

DURING the last 25 years great advances have been made in the development of chemicals for pest, weed and rodent control. In the past 10 years in particular, many new compounds have been marketed on a world-wide scale for use in agriculture, in industry, in medicine and in veterinary practice.

Chemical names of these compounds have been, in many instances, too complicated for common use, and shortened forms and trade names have been devised. As several of these may apply to the same chemical compound, confusion has arisen in commercial descriptions of products and also in the technical literature.

In an endeavour to reduce this confusion a list of coined names has now been issued by the British Standards Institution (as B.S. 1831: part 1, 1952) for established pest control products, embracing insecticides, insect repellents, acaricides, nematocides, fungicides, herbicides and rodenticides.

These names do not conflict with proprietary names, but are intended for common use to assist users in the identification of the active ingredients of pest control products having otherwise cumbersome technical names. It is emphasised that these names are in no way proprietary, but in order to pre-empt as far as possible their availability as common names they have been recorded, though not registered as Trade Marks, by H.M. Patent Office.

American Names Adopted

Wherever possible, the names adopted are those already accepted as coined common names by the United States Inter-Departmental Committee on Pest Control, and the same system of protection is given by the U.S. Patent Office. It is hoped that the same measures will extend to other countries in due course. During the drafting stages, the Technical Committee has maintained liaison with the Commonwealth countries as well as with the appropriate committee in the United States.

The chemical name assigned to each compound is in accordance with the principles recommended by the Chemical Society of London. Where possible, only the pure active ingredients have had common names assigned to them, and an endeavour has been made to avoid, with a few outstanding exceptions, the use of initials and numbers. These exceptions are made in the cases of compounds which are already so well-known by initials, such as DDT and BHC, that another name would only increase the confusion.

This British Standard correlates the recommended common names with the chemical names and the formulae. Both classes of name are also indexed for convenient reference. The index may afford guidance to those concerned with indexing and abstracting, on the preferred alphabetical arrangement of these names.

Part 1 consists of the names of pest control products already in widespread use and, in view of the urgent need for their simple identification, has been made the first of a series of such lists and published immediately upon completion. Other lists will be issued from time to time.

Copies of this standard may be obtained from the British Standards Institution, Sales Branch, London, S.W.1 (price 2s. 6d.).

Lanolin Shortage Created

THE world-wide slump in the demand for woollen goods has created a serious shortage of lanolin, according to the New York *Journal of Commerce*, surveying the lanolin supply position.

'In Belgium, for example,' the report states, 'woollen mills have been operating at 30 per cent of normal. In Germany, operations have fallen to 15 per cent, while in Great Britain, where normally more wool is woven than in any other nation in the world, the industry has been at a virtual standstill'

Wool grease production in the United States is now 20 per cent below normal levels. In other countries, the position is the same. Large stocks of crude grease, accumulated by some producers in anticipation of such a shortage, have been liquidated in the last 15 months.

Lanolin refineries are working short time, using the small quantities of crude grease that trickle in at irregular intervals. Regular customers for lanolin are being supplied in proportion to their purchases in 1951.

Any betterment in the supply position must depend upon an improvement in the textile industry in the near future, lanolin producers declare. If wool goods trade brightened up, the logical forces of supply and demand would come into operation.—B.U.P.

The Design of a Chemical Laboratory

by J. R. Majer, A.R.I.C., M.Sc., Ph.D.

SCIENTISTS have, in all probability, always been as discontented with their accommodation as with their research allocations. In the past this has resulted in little more than intermittent grumbling, and scientists have been inclined to accept the well-known gambit of the new employer that a whole new laboratory block is being planned, but that with present restrictions, etc., etc. . . . More recently, however, there has been an increased interest in the subject of laboratory design, and there is a growing volume of opinion which holds that a laboratory is not necessarily a large barn equipped with a number of unusual services, but a functional building which could and should be designed for the convenience of its users. This interest may have been stimulated by the programme of laboratory building at Harwell, where design had to be considered, or it may be due to the natural growth of research organisations and laboratory supply companies. In either case this opinion has manifested itself in the form of meetings, discussions and books.

About two years ago the Institute of Physics organised a large meeting at the Royal Institution in which the problems of the design of physical laboratories were discussed. This was followed later by the meeting of the Royal Institute of Chemistry at which present-day chemical laboratories were adversely criticised. The most significant book which has appeared upon the subject, has to our discredit, originated in America—the National Research Council Report on the Design, Construction and Equipment of Laboratories, edited by H. S. Coleman under the more manageable title of *Laboratory Design*. The main drawback to this volume is that it is almost completely concerned with the erection of new premises, a process which promises to become even rarer than before with present restrictions upon building and capital expenditure. For some years to come we may have to be more interested in the most successful way of adapting existing premises and a handbook written with this purpose in mind would be of the greatest value. For the present, however, we shall confine ourselves to the theoretical new laboratory.

Construction

It would be pointless, even if it were possible, to discuss in a short article, the details of the shell of the building. The façade and framework are usually of secondary importance to the scientist working inside, and the decision whether to build in brick or reinforced concrete will often be decided by factors unconcerned

Main laboratory of Prices (Bromborough) Ltd., Birkenhead (J. W. Towers & Co., Ltd.)

with the function of the building. Let us suppose, then, that we have the conventional modern steel framed building. The first concern of the laboratory designer will be the construction of the floors, ceilings and inside walls.

Building Materials Selection

The selection of building materials for the floors, walls and ceiling of a laboratory is influenced by a large number of considerations. The material must be reasonably priced and easily available. It should have the required mechanical strength without creating too large a load by virtue of its own weight, and it should have considerable resistance both to abrasion and chemical attack. It is preferable that the material should be non-porous and readily cleaned by the conventional cleaners, as well as being durable and reasonably cheap to maintain. The adverse conditions which such a material must endure will vary with every individual laboratory, but we can suppose that in almost any chemical laboratory the ceiling will be exposed to uneven heating, condensation of moisture, and contact with acid fumes. There may also be organic vapours and dust. Under the impact of these influences the material must not buckle, rot or corrode, soften or scratch.

Laboratories have been described in which the walls and ceiling are movable so that unforeseen projects may be handled; but this type of laboratory will not appeal to many as it raises many more constructional problems. It is as well to note, however, that with such an arrangement the materials of construction must be considerably lighter to allow for easy dismantling.

The value of a pleasant, well-decorated laboratory has been stressed, and this may be taken into account at the design stage.

The constructional materials and method of arrangement will be influenced to some extent by the manner in which the laboratory services, water, gas, electricity, pressure and vacuum are distributed. There are three main methods of arrangement (four, counting the old method of attaching the pipe or conduit to whatever appeared handy). In the designed laboratory, as in the modern house, the tendency is to attempt to conceal the services, without at the same time destroying their accessibility. To achieve this end the pipes may be suspended from the walls, built into the floor, or attached to the ceiling and hidden by a false suspended ceiling below them.

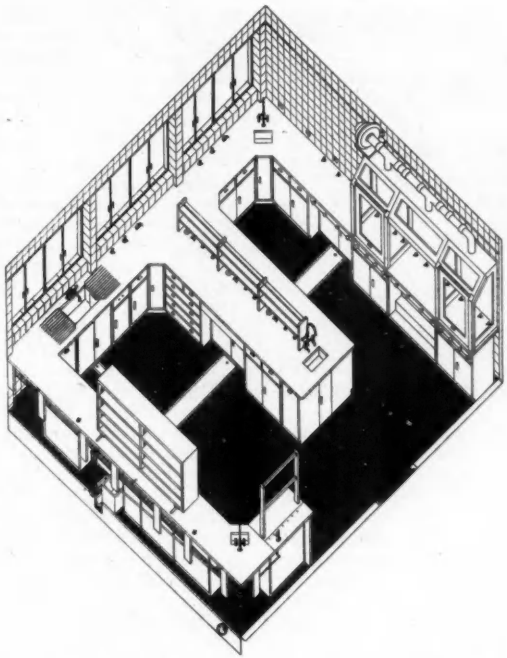
Each of these methods has advantages and corresponding disadvantages. If the pipes are suspended from the walls just below bench level then they are easily accessible to the mechanic, but are exposed where the bench ends, and cannot be supplied invisibly to island benches. If they are built into the wall itself they become less accessible and require a greater wall thickness. The provision of floors with hollow sections overcomes these difficulties, but only comparatively small pipes can comfortably be accommodated, and a separate provision must be made for air ducts. The use of a false ceiling can house the largest ducts, but then there must be vertical distribution to the benches, and the pipes must be reached by a ladder or steps.

In the modern laboratory building the floors will usually be constructed in concrete and it is advantageous when such a construction is envisaged to make sure either that the concrete itself is not unduly porous and permeable to moisture, or if it is, then to ensure that it is covered by some impervious material. It has been suggested that when concrete floors are used the service pipes should be laid on the rough slab and covered with a filler up to floor level, the pipes being raised or lowered vertically to their points of application. This method is often used in large buildings in the hotter climates to eliminate comfortable cavities for the breeding of a variety of insects.

The difficulty of its application to laboratory services is that the repair and replacement of faulty services becomes a very difficult business. Some of the difficulty can be circumvented by the insertion of bent steel structures into the concrete to carry the pipes and ducts, and this type of construction can add considerably to the strength of the floor.

Floor Covering Important

The floor covering itself is one of the most important considerations. It should be comfortable to walk on, and be reasonably attractive in appearance although the latter factor must often be neglected when the laboratory must cope with heavy chemical work. The surface should be easy to clean and should not abrade to produce dust in any quantity. It should also, of course, be resistant to the attack of acids, alkalis,



A typical analytical laboratory

Designed by A. Gallenkamp & Co., Ltd.

organic solvents, oils and greases. Coverings which have been used include asphalt tile, painted concrete, linoleum, asphalt mastic, quarry tile, terrazzo, and wood. It is interesting to note that none of these materials obeys all of the requirements, and the perfect laboratory flooring material has yet to be found, at least at a price that would commend itself to the prudent executive. Some new plastic tiles have been recommended as being resistant to chemical attack and more comfortable to walk upon than the unprotected hard surfaces mentioned, but unfortunately there are no detailed comparisons available.

In the past, there has been a tendency to regard the ceiling of a laboratory as the underside of the floor on the next level. The difficulty of making this surface attractive, light-reflecting, and capable of supporting services, has led to the introduction of the hung ceiling, which is in fact a flat board suspended from the underside of the above floor, and carrying between it and that surface all the services such as air ducts, conduits and pipes. It need not necessarily be very strong as it is not exposed to any great stresses, and the chemical attack will be confined to those substances which can reach it in the form of vapour or as suspended droplets and dust. The ceiling can be made of metal sheet supported by metal bars, the metal being stainless if a highly corrosive atmosphere is to be encountered, or wood boards or plastic sheet may be used.

Whatever the material of construction the ceiling must be made in sections and these sections should be readily demountable to provide ready access to the concealed services, and a further refinement can be introduced by incorporating a layer of sound-adsorbing material between the underside of the floor above, and the upper side of the hung ceiling. The finished ceiling must have good light-reflecting properties and must shield any electric wiring and equipment that would be exposed to corrosion such as the chokes and starter switches associated with fluorescent lighting.

The walls of the laboratory will vary

Section of research laboratory of Wm. Smith (Poplar) Ltd., London. Designed and constructed by Griffin & Tatlock, Ltd.

according to their function. Many buildings are designed with internal load-bearing walls and their construction will be determined entirely by the form of the building. There will also be walls which have the sole purpose of space division, and again, some walls which are merely movable screens. The fixed walls will usually be made of stone or brick and either surfaced with plaster or tiled. Sometimes these interior walls may be made more economically of breeze blocks covered with plaster or tile and there are some American laboratories where it has been found advantageous to make them of glass bricks. It is important, if painting a plaster surface, to use a chemical-resistant paint, and in particular to avoid the use of white or cream lead-based paints if sulphur compounds are going to be used in the laboratory. Hydrogen sulphide and volatile organic sulphur-containing compounds, such as the mercaptans, will readily discolour such paints, and one of the many excellent alternatives should be used even if this means a heavier initial cost.

More recently many chemical equipment supply firms have marketed devices intended to circumvent the employment of an excessive number of tall retort stands upon the bench. These usually consist in one form or another of an interlacing grid of vertical and horizontal bars, this forming a stable support as it is affixed to the laboratory wall, the apparatus being clamped to the bars with the conventional retort clamps. When the interior load-bearing walls are being designed it is as well to consider the provision of such a service, and to arrange for grid-supporting members to be included in the wall itself. This is particularly necessary if the wall is to be made of some heavy material such as stone, which will be difficult to work when erected. The most suitable method of achieving the desired end will be to incorporate stainless steel clips or drilled supports in the wall, to which the uprights of the grid may be bolted.

In addition to the fixed walls there will be a number of semi-permanent walls whose sole function is the convenient division of available space. These are best built sectionally so that the constructional material may be salvaged if rearrangements of space should take place, but the construction will vary with the type and number of services which it must carry. Glass blocks laid without mortar, and wooden panel walls have been used for the purpose, but the requirements of low cost and light weight may often demand other materials.

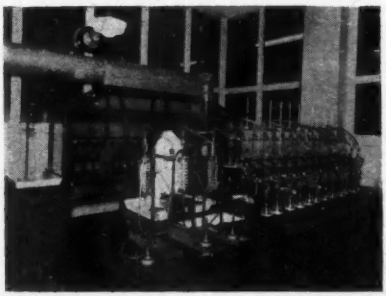
In general a wood or metal frame is erected and the surface made up with lath and plaster, or with panelling. The panels can be made from a variety of materials, metal, plywood, hardboard, plastic or impregnated paper sandwiches containing asbestos or gypsum. There is available in America a system of movable laboratory walls made in metal or asbestos cement and containing an integral internal collection of services. It is claimed that laboratories with their working space divided by these movable walls are more flexible and capable of handling a greater variety of problems. It seems

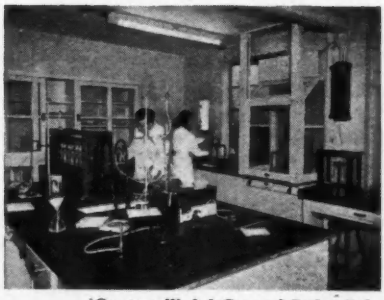
unlikely that this theatrical type of construction, will become popular in this country where cost and simplicity in service systems are the prime considerations. It is interesting to note, however, that this would be one of the possible methods of adapting a building for laboratory use without severe structural alteration.

Many of the older laboratories in this country, both industrial and university, have been built with a minimum of windows, and many of those provided look out only upon the well of a building and face other walls. In addition they are often of the large sash type set in wooden frames. In the design of a modern laboratory there should be an attempt to provide a large steel-frame multi-pane window which can admit sun and air, and a view which is preferably not the window of an adjacent laboratory. The value of such a provision is enormous both on the willingness of the prospective employee to work there, and the readiness of the staff to spend their time there.

It must be admitted frankly, however, that the provision of such a facility, whatever its salutory effect, raises a number of problems. The large laboratory window can reduce lighting bills, provide help in an emergency by acting as an escape route, or by allowing the admission of large volumes of air, but at the same time it may create unfavourable draughts, causing irregularity in the temperature of gas-heated apparatus, and there can be large additions to the heating bill by the escape of warm air. There may be glare from the sun even in our short summer, and most certainly condensation in winter especially if steam baths are being used. Some at least of these objections may be overcome, however, by the use of diffusing glass at levels above the eye, and by the efficient design of the ventilation system. The use of double layer windows can reduce heat losses and if air conditioning is provided the windows need not be opened in winter, the only time any considerable heat losses are likely to occur.

The design of laboratory doors will depend more upon what they must admit than their integral properties. The conventional wood-panelled house door is less suitable for present-day requirements than the flush-fitting door which is built of two layers of comparatively thin wood or metal. This type of door has the advantage of light weight, economy in the use of materials, and simplicity of cleaning. With normal hinges quite large doors may be hung if they are constructed in this manner from ply or plastic, or lightweight aluminium alloy panels. If there can be an advantage from borrowed light diffusing from the outside corridor or room, then the upper half of the door can be glazed, preferably with diffusing glass—if privacy is to be maintained. The use of large all-glass doors made of plate glass is a luxury which will be reserved for the expensive restaurant, and though such a door may have its value in locations where excessive corrosion and humidity would affect the conventional types, the designer will be more attracted by resistant metals and corrosion-proof coatings. Fireproof and sound-proof doors must be designed separately with the immediate problem in view. They are likely to be much heavier





[*Courtesy, W. & J. George & Becker, Ltd.*

Left: Portion of the laboratory of Arthur Guinness Son & Co., Ltd. Right: The laboratory at the Penge factory of George Borwick & Sons, Ltd.

and more expensive than those already mentioned.

The door accessories such as hinges, escutcheon plates, doorknobs and locks should also be made of some corrosion-resistant material if they are to be exposed to chlorine or acid gases such as sulphur dioxide and hydrogen chloride. It must also be remembered that many materials tarnish with hydrogen sulphide, and these should be avoided or protected by chromium plate or a lacquer finish. It is instructive to recall that in a recent survey of the deterioration of chemical weights in the corrosive atmospheres of laboratories, carried out by the National Physical Laboratory, the material which showed itself to be most resistant was stainless steel.

The selection of paints for use in the laboratory has already been mentioned, and it is merely necessary to add that the most suitable media for such paints are the synthetics such as the vinyl alkyd or acrylic resins; rubber-based paints are also applicable. In general it is better to have the window frames and other laboratory furniture which are exposed to corrosion, pre-treated with enamel and baked if this is a practical proposition.

Furniture and Fittings

The previous section has been concerned totally with the constructional aspect of the problem and it is now pertinent to examine the equipment and servicing of a laboratory.

Before discussing laboratory furniture itself it is of value to note that much time and trouble can be saved in the equipping of a laboratory if the type of furniture which it is meant to house is kept in mind at the design stage. In particular the walls should be accurately vertical and the floors level if large rectangular units are to be incorporated, and if any of the units are particularly heavy then some provision must be made for supplying them with a steady foundation and preventing any settling. Similarly, vibration must be excluded from a space to be occupied by a microbalance, or kept enclosed if the space is to contain a shaker. The first concern at the equipment stage will be the mounting of the laboratory benches.

The Laboratory Bench.—In the past the benches were made by the carpenters who constructed the laboratory itself, but now it is possible to order a complete bench unit from one or other of the laboratory furnishing companies, and there are a range of these units for serving the needs of a variety of operations. Some still think that the needs of a special laboratory are best served by having the benches designed and constructed according to specifications, but in general it is better to provide a bench with as universal an application as possible, in order to anticipate changes in its function, and the standard units in the catalogue are thus often preferable.

The Bench Top

The working surface or top of the bench is most commonly made of wood, usually about an inch in thickness and heavily waxed. The book *Laboratory Design* suggests a surface made of strips of glued birch or maple, treated with potassium chlorate and alternate coats of copper sulphate, hydrochloric acid and aniline oil. A jet-black appearance is obtained by oxidation with potassium bichromate. Where the surface may be subjected to excessive amounts of moisture or solvent attack, then it may be advantageous to construct the top of slate or hard soapstone, but these materials have the disadvantage of being fatal to glassware. Synthetic compositions include asbestos cement, and 'Masonite.' Other tops which have been tried for various reasons are rubber, linoleum, tile, stainless steel and lead.

The height of the bench should be approximately three feet and it should not be more than three feet deep—it may be as long as the available space permits. It should contain a kneehole, and adjacent to it a series of drawers of the conventional type. A pull-out flat panel above the top drawer and just below bench level is also an asset. If island benches with working space on either side are used, then these may contain very long drawers which can hold lengthy pieces of apparatus such as Liebig condensers, tall fractionating columns, or stocks of glass tubing. The doors of the storage cupboards underneath the bench may either swing or slide, the latter type conserve space but are liable to stick if the grooves become obstructed with dust or swollen by water.

The cupboards themselves can contain removable racks for flasks, etc., and there should be at least one compartment which can be used for drying apparatus. This can

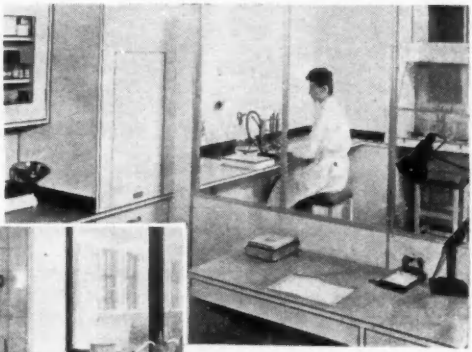
consist of a large wire grid to support the wet apparatus, and some means of heating, either by a hot water or steam pipe, or with an electric element.

The problem of where to place the sink is one which will have to be resolved with each separate laboratory in mind. With island benches there is a great deal to be said for placing a sink at each end of the bench with a connecting trough dividing the two working spaces. With wall benches, on the other hand, it is frequently more suitable to place a rectangular sink longitudinally in the centre of the bench—a transverse placing may save space but is usually more awkward to use. The runaway for waste water such as the cooling water from condensers may be provided by a trough at the back of the bench, or, more neatly, by a number of small wells connected to a large diameter waste pipe below bench level. One or more of these wells should have associated water supply and taps suitable for the installation of a metal, glass, or plastic water pump.

The main sink will usually be constructed of ceramic ware or glazed porcelain, and where there is little likelihood of exposure to thermal and physical shock these are preferable to sinks of metal, wood or stone. Sinks which are exposed to constant attack by corrosive chemicals should have a continual stream of flushing water, and it is important that the trap attached to the sink should be as resistant as the sink itself.

When the sink is to be used for the washing of apparatus, then a number of other facilities must be provided. These include a tap for delivering hot or cold water—the hot water supplied either from a steam line or by a conventional water heater—a high gooseneck tap for washing out lengthy pieces of apparatus, draining boards for the accommodation of cleaned apparatus, and pegboards and wire racks for holding both clean and dirty glassware. Bottle-washing sprays and motor driven brushes are luxuries which will not usually find their way into a chemical laboratory, but for analytical work the provision of a distilled water tank at the wash sink is a valuable adjunct.

Chemical stoneware sinks can be very lethal to fragile glassware and sometimes the effect has been minimised by the use of lead liners or rubber mats. These have the respective drawbacks of high cost and sensitivity



Picture on right shows the widespread use of 'Formica' in the aseptic laboratory and preparation room of St. George's Hospital, London

Research laboratory showing bench tops veneered with 'Formica' which is manufactured by Thomas De La Rue & Co., Ltd., London

to organic solvents. If large quantities of chemical wastes are to be disposed of, then a special sink which is kept continually flushed should be used, and it is important, especially if the local sewage works employs a filter bed to keep the concentration of chemical waste to as low a value as possible.

The space above a bench is conventionally used for the storing of reagent bottles and small quantities of chemicals. These may be accommodated in open narrow shelves in the manner of a small bookshelf, or they may be housed in small cupboards. In the latter case it is better to provide glass fronted sliding doors to prevent the overturning of tall apparatus by an open door. The shelves are best protected from chemical action by a sheet of glass which can be cleaned easily and quickly.

Fume Cupboards

The disposal of objectionable fumes is now almost invariably carried out mechanically by the use of fans. These fans must be sheathed in some inert material such as rubber to protect the working parts from corrosion, but if very corrosive atmospheres are to be maintained then it is sometimes preferable to evacuate the fume space by means of an induction draught from a high-velocity air stream. In either case the venting and ducting must be designed to obviate the use of high-velocity noisy fans, and carry the fumes without obstruction to a chimney or high point well away from the intake ventilation ducts of nearby buildings.

An air speed of about 1 ft. per second is sufficient for carrying away the fumes, but the velocity inside the ducting should be much higher than this. The air entering a fume chamber will normally be withdrawn from the laboratory, and at high fan speeds and small openings of the chamber window, this can create unpleasant draughts both in and outside the chamber, deflecting bunsen flames. To avoid this some alternative source of air should be provided and if the chamber is built near an outside wall this can be simply accomplished. The air speed inside the ducting is best kept below 15 ft. per second, and the most efficient cross-section for the duct is circular, with square and rectangular sections coming second and a bad third respectively.

Constrictions at elbows and junctions lower the efficiency and some means of draining ducts which must handle the moisture from steam baths is essential. The conventional method of building a fume cupboard has been to use an outside wall of the laboratory as the back and provide a stone or tiled shelf as the base, the frame being made of stout wood and the windows of plate glass. The front window is made with sashes and raised like a normal house window. A more imaginative style was recently exhibited in Germany, in which the front window was curved and rolled back after the manner of a roll top desk lid. Canopy hoods or open-fronted fume chambers cannot be recommended for general use as they do not provide protection from the unexpectedly rapid evolution of fumes or the explosive reaction.

There are many possible materials of construction for fume chambers, but one which must deal with all contingencies is best made from chemically resistant white tiles and strengthened glass. It should be provided with gas and water points which can be adjusted without opening the window, and a drainage system. Bottles of corrosive and dangerous chemicals should not be housed in a working fume cupboard as the labels will be destroyed in a short time by the fumes, leaving the unhappy chemist with the problem of identifying or disposing of a collection of highly unpleasant substances.

Services

A laboratory will most commonly be supplied with water from the mains or from a private well, steam and hot water, and, more rarely, distilled or demineralised water. The steam pressure normally required in a laboratory for heating water or distillation of organic liquids will be of the order of 15 p.s.i., and although the main steam lines will be at a higher pressure than this for transmission purposes, where high-pressure steam is required on the small scale it is preferable to use a motor-driven compressor. Hot water may be supplied from a heated storage tank or from an instantaneous heater working from the steam line or from gas or electric power. All systems have their advantages and the local circumstances will decide the choice.

The water supply to the laboratory from the mains or a factory well may not be at a sufficiently high pressure, especially if the laboratory is near the top of a tall building, and in this case it may be necessary to install a booster pump so that water pumps, etc.,

may be operated satisfactorily. It is often preferable to have a separate supply of drinking water and water for first-aid purposes or, if—as in most metropolitan areas—all the water is satisfactory, to label and reserve taps for drinking purposes.

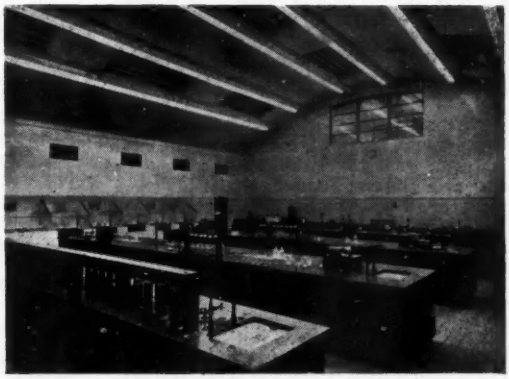
The supply of demineralised or distilled water is also a matter for local circumstances to decide. Mains or well water can be freed from the sulphates, carbonates and bicarbonates of sodium, potassium, calcium and magnesium, by passing it through columns of synthetic resins. This process is cheaper than distillation because of the ease and cheapness of regeneration of the resins, but in many cases this purification may not be sufficient, and water used must then be freed from gaseous and organic impurities.

If many laboratories are to be supplied, then the manager must decide whether to equip each with a small still or to install a large still to supply all the needs. In the latter case it will usually be found more economical to pipe the distilled water to the laboratories than to carry it in carboys. The piping, however, should be of resistant material which will not recontaminate the supply—pyrex, aluminium or tin will be found suitable, but the cost of the last is prohibitive. In rarer cases conductivity water may be required, and then a special still must be installed.

Compressed Air.—A supply of compressed air at a pressure of between 5 and 10 p.s.i. will often be found useful for such tasks as the operation of air turbine stirrers, bubbling air through liquids, removing traces of organic solvents from glassware, etc. The air can be supplied either by a rotary-motor-driven air pump or by a reciprocating compressor, and, if the air is desired to be free from traces of lubricating oil, a non-lubricated reciprocating compressor should be installed. The air circuit should include a reservoir so that the pumps are only used intermittently and the air supply to them should come from a clean, cool situation.

Vacuum.—One of the most frequent causes of irritation in a chemical laboratory is failure of vacuum. For most small-scale filtrations and distillations at reduced pressures of 25 mm. and above, most use will be made of the inexpensive water pump. The metal or plastic varieties can be screwed direct to the pipework and are extremely durable. As they are dependent for their maintenance of vacuum on the pressure of the water mains, they have the deplorable habit of delivering water to the evacuated receiver if the mains pressure falls. The provision of a trap may prevent disaster but does not remedy the original defect.

To avoid this uncertainty the installation of a motor-pumped vacuum line is often resorted to. The rotary vacuum pump must, however, be protected from liquid and gases which may enter the line by means of a trap, and as in the previous section a reservoir will give a more even service. A line of this type may be used for filtrations and for evacuating desiccators, etc. For distillations at pressures down to 1 mm. of mercury a rotary vacuum pump can be used, and this is usually a portable affair which can be wheeled or carried to its point of use. For



Laboratory illumination provided by specially constructed Mazda cold-cathode tube lighting arranged in continuous lines in the main research laboratory of the Yorkshire Copper Works

Courtesy British Thomson-Houston Co., Ltd.

the maintenance of really high vacua down to 1×10^{-4} mm. of mercury a multiple stage mercury vapour pump, backed by a high-grade rotary vacuum pump is necessary. If a line with several points is installed to operate at these pressures then special care must be taken, all pipe joints being specially ground, and liquid air and phosphorus pentoxide traps included in the system. All these types of pumps must be protected from the attack of corrosive vapours which rapidly impair their efficiency.

Gas.—In general, gas installation is the least of the designer's headaches, mains gas being supplied at suitable pressures for most laboratory purposes, and only the glass blowing department may require higher pressures than these, which must be produced by means of a gas booster pump. If mains gas is not available or is cut off in an emergency then gas may be supplied from cylinders, but this is an expensive business.

Refrigeration.—Most research laboratories will require a space refrigerated to near 0° C., as well as facilities for storing ice and solid carbon dioxide. A small room refrigerated with chilled brine can be used for storing labile chemicals or for chilling slowly crystallising solutions, and most organic chemists will appreciate the need for a store of material for local cooling.

Lighting and Power.—The efficient lighting of laboratories is dependent upon many factors, not the least of these being the reflecting capacity of the walls and ceiling, and it is important that the surface of these should not be allowed to darken and deteriorate and so reduce the general illumination. The high standard of illumination required by such tasks as the reading of thermometer scales, verniers, meters and gauges can seldom be maintained over the whole laboratory even if such a proposition were economically feasible. It is then more realistic to suggest a good general illumination with diffused light so as to avoid glare and a supply of small local lights for the more exacting tasks.

The most efficient form of diffused lighting is provided by the use of fluorescent tubes. The initial installation will frequently be more expensive than the comparable system of incandescent lamps but their greatly superior output of light per watt reduces their running costs. The tubes are mounted along the length of the bench, and although the glare from the tube itself is rarely disturbing it is an advantage to shield the eyes of the worker at the bench from the direct light. Each bench shou'd be provided with a number of adjustable lamps to provide an increase of local light where and when desired. In particular the designer should not forget the fume cupboard, which is frequently a dark and shadowy place where the worker's task is magnified by having to peer through misted windows.

A laboratory requires electric power to operate such devices as electric heating mantles and elements, stirrers, shakers and fans. Each bench should be provided with a number of earthed safety sockets and at least one of these should be capable of supplying 15 amps. The designer may be undecided whether to allow for multiple circuits of A.C. and D.C. at different voltages or to supply each laboratory with the requisite transformers and rectifiers. For the general laboratory the latter method is more suitable as most devices can be bought to operate from the supply available but this has the disadvantage that unusual conditions may create a demand for an uneconomical amount of electrical gear. The most useful accessory for a laboratory with only one supply is a bank of Variac transformers.

Fijian Manganese Ore

Prospecting in the past three years has revealed the existence of exploitable deposits of manganese ore in western Viti Levu, the largest island in the colony of Fiji, and an export trade is gradually being built up. In January 1952 nearly 1,300 tons of ore were exported, 1,003 tons—most of which was mined during 1951—to Japan, and the remainder to the United Kingdom. Owing to transport difficulties only 240 tons had been exported during the whole of 1950, and 631 tons in 1951, mostly to the United Kingdom.

Search for Strategic Minerals

The possibilities of new supplies of copper and sulphur in Chile are being investigated by geologists and specialists representing the United States Purchasing Agencies for Strategic Materials. The agencies, it is stated, would be prepared to help financially in the development of suitable sources of strategic minerals.

Pure Oxide Laboratory Crucibles

by G. K. STANFIELD, B.Eng.

PURE oxide crucibles have found application in laboratories because of two principal characteristics—refractoriness and chemical inertness. The refractoriness enables such ware to be used in temperature ranges above the more common ceramic products and chemical inertness is, of course, of great importance in research where contamination would be deleterious. Some of the pure oxides which are often used are given below.

Refractory	Formula	M.P.	Limit of application
Alumina	Al_2O_3	2050° C.	1950° C.
Magnesia	MgO	2800° C.	2400° C.
Beryllia	BeO	2570° C.	2400° C.
Zirconia	ZrO_2	2700° C.	2500° C.
Thoria	ThO_2	3050° C.	2700° C.
Lime	CaO	2570° C.	2400° C.

In general, four methods of manufacture of pure oxide articles may be listed, 'slip casting', 'tamping or pressing', 'hydrostatic pressing' and 'hot pressing'. With reference to such ware as laboratory crucibles, the first three of these are of importance.

(a) Slip Casting

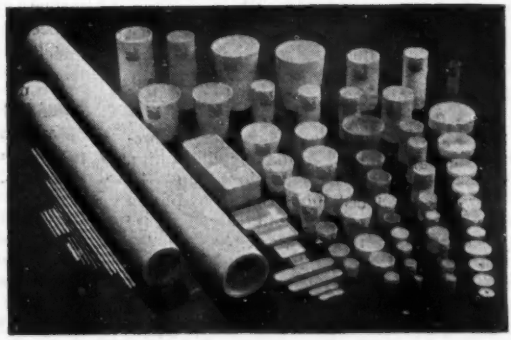
Slip casting consists of pouring a suspension of the oxide into a plaster of Paris mould and leaving for a sufficient period of time for a desired wall thickness to build up on the mould surfaces. The preparation of suitable casting slips is often a long and laborious process. The pure oxide material must be very finely ground, great care being taken to introduce the minimum possible amount of impurity during the milling. Any impurity picked up must be most carefully removed, for example, iron, as may arise from the use of metallic mills, must be washed out with acid, as otherwise, severe staining of the finished article would result. The final slip consists of about 80 per cent by weight of the pure oxide suspended in water (usually) to which a small quantity of deflocculent is added, generally making the slip slightly acid or alkaline. Dependent upon the properties of the individual slip and on the wall thickness desired, the time taken for the actual wall build up may vary from, say, 3-30 minutes, whereafter the remaining fluid is poured away. After a very short time, edges may be trimmed with a sharp knife and demoulding is possible after about 30 minutes. The use of slightly tapered moulds facilitates removal, as the 'setting' shrinkage is often very low. In this 'green' state, the article is fragile but may be handled with care and after a period of drying the ware is ready for firing.

(b) Pressing or Tamping

Pure oxide powders, of a slightly larger grain size than for slip casting, may be successfully tamped or pressed. In this case, however, the addition of a temporary bonding agent is necessary if green strength is of importance. If such a temporary bond is used it is generally of organic nature so that it will be burnt out on firing. The moulds used must, of course, be much more robust than for slip casting and are always of metal, usually brass.

(c) Hydrostatic Pressing

Hydrostatic pressing is based on the fact that the application of pressure to a liquid



Pure oxide laboratory ware

[Courtesy The Morgan Crucible Company, Ltd.

induces an equal pressure to be exerted throughout the whole volume of the liquid. In the manufacture of an oxide crucible by this process, the refractory is inserted in moulds which are in turn inserted in perforated steel 'forms'. These are introduced into the pressure chamber and a pressure applied by a piston, which is transmitted to all available surfaces of the article being made *via* the perforations in the steel form. This method is somewhat tedious on account of the careful preliminary preparations, but has the advantage of submitting the article to uniform pressure which obviates the possibility of pressing laminations.

Firing

Articles in the green state produced by any of the above methods (except hot pressing) must be fired before they are ready for use. Firing must be to such a temperature that stability is provided at the intended operating temperature. For example, a crucible for use at 1,400°C., must be fired to, say 1,500°C. However, much higher temperature firing often produces very desirable properties, viz., mechanical strength and imperviousness. At temperatures of 1,750°C. to 1,800°C. upwards, some of the oxides undergo 'recrystallisation' to the extent that if, for example, an alumina crucible is maintained at a temperature of 1,800°C. or above, the final body consists of a mass of interlocking crystals, and it is this structure which imparts the strength and non-porous nature.

General

Of the above methods, slip casting and straight forward pressing are the most economically important. Slip casting is the only suitable method for producing very thin walled crucibles. Articles with walls down to 'egg shell' thickness can be produced, which are, of course, much more thermally shock-resistant than the thicker walled articles produced by pressing.

Most of the pure oxides, however, do present their own peculiar making difficulties. In the case of lime, precautions must be taken to prevent crumbling due to hydration during manufacture. With beryllia are associated dangerous toxic effects to the operators; for zirconia the crystal structure must be 'stabilised' (generally by addition of small amounts of magnesia or lime) to obviate the large reversible thermal expansion which, if unchecked, leads to disruption of the article on firing. In the case of thoria where the raw material is very expensive, it has been found economic to line alumina crucibles with a thin coating of thoria instead of making the article in thoria throughout. This is simply done by casting the thoria inside the preformed alumina crucible and subsequently firing.

Laboratory Applications

As previously remarked, the properties which particularly recommend pure oxide ware for laboratory use are the high temperatures to which they can be used and their chemical inertness. They are often used where, for example, the more expensive platinum or silver vessels have previously been used, for precious metal melting and for such researches as, for example, special glass development and pure metal and alloy equilibrium investigations. Of interest is their application to high frequency melting where the effect of severe thermal shock is overcome by the choice of very thin-walled pure oxide containers which possess ample mechanical strength for this purpose.

Alumina

Alumina is the most widely used of the pure oxides, particularly in the recrystallised form of 99.8 per cent plus purity. It is suitable for melting and containing many metals including nickel, cobalt, copper, zinc, etc.; under hydrogen, or in some cases neutral atmospheres, it is the best material for use in contact with iron, steels, chromium, calcium, sodium, etc. Alumina has been used successfully for many acidic and alkaline fusions and for containing oxides and salts including caustic alkalis, sodium cyanide, sodium and potassium carbonates and chlorides, etc. Many glasses, slags and minerals may also be treated in recrystallised alumina ware.

Magnesia

Magnesia is fundamentally basic in character and is thus specially suitable for contact with basic melts. Among applications where magnesia has been reported more successful than alumina, are the melting of silica and in the preparation of pure manganese and certain special alloys. The use of magnesia is often limited to temperatures well below its melting point (2,800°C.), because of its tendency to volatilise; it is generally

considered, however, to be suitable for use up to about 2,000°C.

Zirconia, Beryllia, Thoria

Zirconia is suitable for many of the applications of alumina, but is, perhaps, not so successful under reducing conditions. Beryllia has been used, among other things, for research on pure beryllium. Thoria, either *per se* or as a lining inside alumina, has proved satisfactory for melting titanium, pure platinum and similar metals at temperatures above 1,800°C.

Conclusion

It may be said in conclusion that in the preparation and use of pure oxide laboratory ware, the stage has been reached where many of the original manufacturing difficulties have been successfully overcome and the products are of a high quality standard; this, together with the peculiar properties of pure oxides, has had considerable influence on the development of high-temperature research work and has enabled the establishment of their application to many varied and special purposes and for treating materials otherwise considered corrosive. There is little doubt that the future will see these fields of use considerably widened.

Editor's note : Mr. Stanfield is an employee of The Morgan Crucible Co., Ltd., London, and we are indebted to the firm for their co-operation.

Overseas Students' Group

AT a meeting held at the Society for Visiting Scientists, Ltd., on Wednesday, 19 March, 1952, the Overseas Science Students' Association was instituted and rules adopted.

The proposal that such an Association should be formed was adopted at an earlier meeting when Sir Harold Spencer Jones, the Astronomer Royal, addressed a number of overseas science students at the Society for Visiting Scientists, Ltd., on 27 February. The objects of the Association are to bring graduate science students from overseas into contact with the scientific life of Great Britain and to bring such students into contact with one another. The Association is affiliated to the Society for Visiting Scientists where its meetings will be held. It proposes to fulfil its objects by arranging scientific meetings, arranging visits to places of scientific interest and by other means.

Its executive committee was elected at the meeting on 19 March as follows:—*President*, Mr. W. J. De Coursey (Canada); *Secretary*, Mr. P. Sen (India); *Treasurer*, Dr. J. Pepys (South Africa); Mr. P. Mildner (Yugoslavia); Miss E. H. Nelson (U.S.A.); Miss M. E. De Jager (South Africa); Mr. M. Ramasamy (Ceylon); Dr. Sutarman (Indonesia); and Mr. J. Thabit (Iraq).

About 100 overseas science students have already joined the Association and further applications are invited and should be addressed to Mr. Sen, care of the Society for Visiting Scientists, Ltd., 5 Old Burlington Street, London, W.1.

International Court Action

THE Dominion Tar & Chemical Co., Ltd., of Montreal, has started a $5,000,000 court action against the International Salt Co. of the United States, and its subsidiary, International Salt Co. of Canada, Ltd. The Montreal firm filed a writ claiming that the United States company broke an agreement for the joint mining of rock salt along Lake Erie. Dominion Tar & Chemical Co. said they started preparing the action shortly after an announcement from Chatham, Ont., on 8 March, said that International Salt would erect a $3,500,000 plant at Erieau, 20 miles south of Chatham.

The Canadian company is asking the Supreme Court of Ontario to declare there is a partnership between International and the U.S. firm to produce rock salt. The alleged partnership is for the production of rock salt in industrial work. The product is as yet not produced in Canada.

The Montreal firm asks the appointment of a receiver until the 'joint adventure' can be wound up. It also seeks an injunction restraining the American company and its Canadian subsidiary from excluding the plaintiff from any part of the land now in dispute.

Dominion Tar and Chemical also seeks full access to all books of account or other documents and asks the court to restrain the defendant from entering into other agreements relating to the 'joint adventure'.

The writ would have the court restrain International from collecting any money on behalf of the project and seeks dissolution of the partnership.

Indian Newsletter

(From Our Own Correspondent)

FIGURES for the estimated production of thorium oxide and rare earth compounds at the Indian monazite factory, and recent finds of rare minerals, are contained in the annual report of the Ministry of Natural Resources and Scientific Research for 1951-1952. It has been stated that the monazite factory in Travancore will be capable of producing about 800 tons of mixed rare earth oxides per annum. The production of thorium hydroxide is expected to be around 127 tons. In addition, as an important by-product, 15 tons of uranium oxide will be recovered and also some 1,800 tons of trisodium phosphate. Several new finds of beryl and atomic minerals have been located in India by the rare minerals survey unit of the Indian Atomic Energy Commission. The commission is in touch with similar organisations abroad and it is reported that an agreement has already been reached between the Indian body and the French Atomic High Commission for close collaboration on certain aspects of atomic work.

* * *

In an intensive search for sulphur-bearing minerals the Geological Survey of India has located potential reserves in a number of places. The latest find is at Amjhor, where pyrites to the extent of 50,000 tons is estimated. Exploratory mining in an area of 250 sq. ft. yielded about 330 tons of the mineral containing on an average of 40 per cent sulphur. Geophysical methods of prospecting have brought to light sulphide ores in old pits of Chitaldrug (Mysore) and in Polur (Madras). The latter shows an extended vein of considerable length with an average sulphur content of 25 per cent. At Wynaad (Madras) there is known to be a vast amount of auriferous pyrites and detailed work is proposed to recover both gold and sulphur. The recovery of the element in the smelting of copper and lead in the country is also receiving serious attention.

* * *

Installation of a new pig iron plant to meet the growing industrial needs of India is being considered by the Government of India according to the Minister for Works Production and Supply. The plant will have a capacity of 3,500,000 tons of pig iron which is above the current Indian production. The Government of India has sanctioned a loan of Rs.20,000,000 to the State of Mysore for the expansion of the iron and steel works at Bhadravati. The State will start a new fertiliser factory in the same place, for which financial assistance from the World Bank has been sought.

* * *

A modern silver refinery at a cost of Rs.6,000,000, is proposed as an adjunct to the new Rs.22,000,000 mint opened recently in Alipore, Calcutta. This is intended to refine the quaternary alloy silver coins by a special process which, it is claimed, would be appreciably cheaper than processes employed in other countries. The new Alipore mint has the most up-to-date equipment and a distinctive feature will be the production of pure nickel coins for which special machinery has been installed. The mint has a capacity of 1,200,000 pieces per eight-hour shift and may also undertake external orders.

* * *

Establishment of DDT factories in India and other countries of South East Asia forms part of a comprehensive plan contemplated by the World Health Organisation. India will shortly have a factory either at Bombay or Delhi with an annual production of 700 tons, as a joint venture by WHO, UNICEF and the Government of India.

Chemistry Lectures Abroad

PROFESSOR John Read, F.R.S., Professor of Chemistry at St. Andrews University, is to lecture for the British Council in Austria and Italy. He will leave for Vienna on 28 April where he will give two lectures in German. The first, a historical study of the origins of chemistry, under the title 'A Prelude to Chemistry,' will be given to a general audience, and the second 'Some Researches in Stereochemistry' to specialists.

On 1 May he will go on to Italy where he is already well-known as the winner of the 1949 Cortina-Ulisse European prize for his book 'A Direct Entry to Organic Chemistry,' and for his lecture tour in 1950.

He will lecture on 'A Prelude to Chemistry' in Milan, Pavia, Padua, Bologna and Rome and will also visit Ferrara, Assisi, Sena and Perrugia. His tour ends on 21 May.

Platinum Metals in the Chemical Laboratory *

LABORATORY crucibles were probably the first useful articles to be made of platinum when it became available in malleable form at the beginning of the nineteenth century. John Cocks, in 1805, made platinum crucibles weighing about five ounces each which were probably intended for scientific investigations and for small-scale manufacture of medicinal chemicals.

The interest in the combining weights of the elements, and the powerful and clarifying influence of Berzelius on this subject, were the bases on which methods of accurate quantitative analysis were founded in the early years of the century. Platinum was well known through the work of Wollaston, who was also an active controversialist in the matter of equivalent and combining weights, so that its remarkable utility for the manufacture of analytical apparatus was quickly recognised.

The chief need at this time was for crucibles and dishes of various shapes and sizes; for a number of years they were almost the only kind of platinum apparatus. When electrochemical methods of analysis were first introduced, by Wolcott Gibbs in 1864 and by Luckow in 1865, crucibles were used as cathodes, with platinum wire or foil anodes, and it was not until 1899 that platinum gauze was first used in the construction of electrodes.

Progress in Design

During the latter part of the nineteenth century many pieces of apparatus intended for particular purposes were introduced. Still in use little changed are the tall narrow crucible designed by Lawrence Smith in 1871 for alkali determination, and the perforated filtering crucible introduced by F. A. Gooch in 1878, modified later by C. E. Munroe who devised the fixed filtering pad of spongy platinum which replaced the asbestos mat used by Gooch.

Much apparatus was made to the design of individual users, or for a particular purpose, and during the course of years a great variety of different patterns came into being. More recently there has been a tendency to eliminate many of these, and to evolve simple robust forms of apparatus in a limited range of types and sizes sufficient for essential needs, each of which can be manufactured in sufficient number to obtain the economies of quantity production.

Microchemical Apparatus

The introduction of microchemical methods of analysis during the present century has brought with it the need for platinum apparatus which is of very small capacity and light in weight. Most of the pieces—crucibles, dishes, filtering crucibles, electrodes—are of familiar type but a few, like the Emich filter stick, have been devised solely for microtechniques.

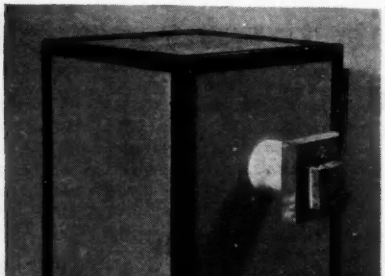
The Purity of the Platinum

One of the principal difficulties of the refiner is to make a complete separation of

* This article is based on information supplied by Johnson, Matthey & Co., Ltd., 73-83 Hatton Garden, London, E.C.1.

[Courtesy Johnson, Matthey & Co., Ltd.

A battery of electrochemical analysis units: the Fischer-type anodes and cathodes have platinum alloy stems and frames and pure platinum gauze



[Courtesy Johnson, Matthey & Co., Ltd.

An electric resistance furnace wound with rhodium-platinum alloy wire, arranged with gas connections and viewing window, for the determination of the fusion point of coal ash

platinum from the other metals of the platinum group and early platinum ware almost always contained a proportion of other platinum metals, in quantities which varied according to the origin of the raw material. These adventitious additions were often beneficial in their effect on the toughness and mechanical strength of the ware, but they lessened to some degree the resistance to chemical attack and to the effect of repeated ignition.

Modern refining practice is sufficiently good to make available in quantity metal not less than 99.99 per cent pure, which is significantly better than any of the platinum alloys in its all-round resistance to attack. Since the most essential property of gravimetric apparatus is invariability of weight under all of the possible conditions of use, this very pure platinum is generally desirable, although apparatus made from it is somewhat soft and can easily be deformed.

Harder Alloys

In articles where considerable mechanical strength is necessary, alloys containing carefully controlled additions of other platinum metals, iridium, rhodium or ruthenium, are employed. The stems and frames of electrodes exemplify the type of construction where the greatest possible mechanical strength is desired. Where the conditions of use are suitable, crucibles and dishes may be made of a rhodium-platinum alloy; for general service, sufficient stiffness can be obtained by careful design and manufacture. The bottoms of crucibles and dishes are made considerably heavier than the walls, into which they taper smoothly; the rims may have a thickened belt for reinforcement; recently crucibles having domed bottoms have been introduced. These crucibles are both considerably stiffer and much less easily overturned than the ordinary kind.

Manufacture of Apparatus

The making of apparatus remains largely a hand craft. Mechanical aids may be used in the early stages, but finishing is always done by hand. The close surface texture which can be given by skilful hand working has a significant effect on the useful life of crucibles and dishes. The painstaking workmanship given to the construction of platinum laboratory ware is not merely a matter of tradition; careful fabrication and immaculate finish help to give the laboratory worker a sound and reliable tool, and are well justified when applied to so costly a raw material.

Precautions in Use

Although platinum has extremely high resistance to chemical attack, there are a limited number of circumstances in which it can suffer severe damage. Any risk of attack or contamination may be avoided completely, however, and with reasonable care in the normal conditions of laboratory use platinum apparatus will have a life of several years.

Platinum can be attacked by a number of substances commonly encountered in the laboratory. If it is heated in atmospheres containing ammonia, sulphur dioxide, chlorine or volatile chlorides, the surface becomes porous; in atmospheres containing highly carburetted gases or vapours there may be rapid embrittlement through the formation and decomposition of a carbide.

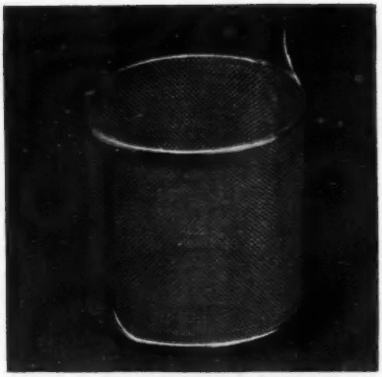
It is rapidly embrittled if it is heated in contact with phosphorus, arsenic, antimony, selenium or tellurium. Carbon and sulphur produce a similar effect but much more slowly. It is dissolved by molten silver and

gold, and by nearly all molten base metals. At temperatures above 1200° C. it is affected by the oxides of iron and lead, and in reducing conditions by silica and silicates.

Damage most frequently arises when platinum is hot, either through contact with another metal capable of alloying with platinum, or through the reduction of an oxide of an element that will combine with platinum. Apparatus should always be heated in an oxidising atmosphere, should be handled with platinum-tipped tongs or forceps, and should be set down only on a clean refractory surface. Although occasional trouble is experienced through the use of fusion agents, such as alkali oxides or peroxides, which are aggressive towards platinum, it is in carrying out ignitions that most cases of damage arise.

Ignitions

As a general rule free access of air should be provided and carbon should be burnt off as completely as possible before raising the dish or crucible to the full ignition temperature. In determining magnesium or phosphorus by the magnesium ammonium phosphate method, precipitation must be strictly controlled to ensure that only magnesium mono-ammonium phosphate is obtained and not a mixture containing the diammonium phosphate, which may cause corrosion because of the formation of the metaphosphate on ignition. Full access of air and complete ashing of the filter paper before raising the temperature to complete the decomposition to pyrophosphate are essential. The precipitation and ignition of magnesium ammonium arsenate require similar but even more stringent precautions. A high proportion of the crucibles which are returned to the makers for repair have been damaged by phosphorus or arsenic.

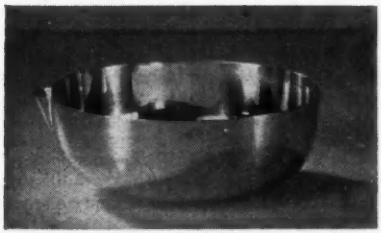


[*Courtesy Johnson, Matthey & Co., Ltd.*

Detail showing the finish of a stock type of electrode

Platinum Wound Furnaces

Although the achievement of high temperatures by means of platinum or platinum alloy wound resistance furnaces is by no means new, they have during the past few years been brought into very general use for combustion methods of analysis. They have been particularly widely adopted in the iron and steel industry for the determination of sulphur by the Strohlein method, and for the determination of carbon in alloy steels. They are generally of the tubular type, wound with a 10 per cent rhodium-platinum alloy resistance wire on a refractory element tube, and mounted in a case containing graded high temperature, medium temperature and low temperature insulation. They are suitable for use continuously at temperatures up to 1,500°C. For combustion analysis an inner impervious combustion tube is usually fitted;



[*Courtesy Johnson, Matthey & Co., Ltd.*

A platinum dish made by hand-raising from a single sheet of metal

[*Courtesy Johnson, Matthey & Co., Ltd.*

The special crucible for alkali determination devised in 1871 by J. L. Smith

if a controlled atmosphere is required, as for the determination of the fusion point of coal ash, an impervious element tube fitted directly with gas inlet and outlet connections is used.

Catalysts

Catalytic combustion is a necessary stage in many analyses and platinum metal catalysts are prepared for this purpose in a variety of forms. Foil is used either in rolls or made up in the 'star' form devised by Pregl; packs of fine gauze serve a similar purpose, or if considerable surface activity is necessary, dispersed catalysts either of platinum or palladium are available on such carriers as asbestos, pumice, silica gel, alumina or charcoal.

Miscellaneous Apparatus

In addition to the regular and familiar types, there is of course a constant need for platinum equipment of special form, particularly for research work, which may often be large and elaborate.

An unusual but increasing use for palladium arises from its permeability to hydrogen and deuterium at elevated temperatures. It is employed in the form of very thin-walled tubes in apparatus for the production of small quantities of very pure hydrogen or deuterium. Impure hydrogen, or a hydrogen containing gas, is fed to the outside of the tube, while the inside is maintained under vacuum. At a suitable temperature above 200°C. the hydrogen diffuses through the barrier and may be drawn from the low pressure side almost free from impurity. Since at room temperature the rate of diffusion is almost zero, the device also serves as a convenient stop-valve.

This particular application is rather physical than chemical, but was chosen as a single example to represent a host of minor uses for the platinum metals in the physico-chemical field, which are altogether outside the scope of this brief review.

Summer Meeting

A Summer meeting of the North of England Section of the Society of Public Analysts and Other Analytical Chemists will be held at the Imperial Hotel, Llandudno, N. Wales, from Friday to Monday, 13-16 June. A paper entitled 'The Analyst in the Plastics Industry' will be given at 10.30 a.m. on Saturday, 14 June, by Dr. J. Haslam, F.R.I.C., of Imperial Chemical Industries, Ltd., Plastics Division.

First Joint Meeting Held

Sir Eric Rideal Delivers Address

THE president of the Chemical Society, Professor Sir Eric Rideal, delivered his presidential address at the joint annual meeting of the Society with the Royal Institution of Chemistry at Trinity College, Dublin, on Wednesday, 16 April. It was the first time that the two bodies had held conjoint anniversary meetings and the first time that either of them had held its meeting in Dublin. Sir Eric chose as his subject 'Colloid Science—A chapter in Chemistry.' A vote of thanks was proposed by Professor C. K. Ingold, president-elect of the Chemical Society and Professor of Chemistry at University College, London. More than 350 members of either the Society or Institute attended the three-day meeting.

In his address Sir Eric recalled that the foundations of the exact science with its own particular discipline and methods were laid when recognition was given to the fact that separating any two bulk phase systems there always existed a third, or interphase—Ostwald's 'Forgotton dimension.' It was with the properties of what the late Sir William Hardy termed 'Matter in the boundary state,' and, with the effect on matter in which by subdivision and dispersion the interphase became progressively a more important factor in determining the behaviour of the system as a whole, that colloid science was concerned.

Emulsions formed one of the most important classes as well as one of the oldest of colloid systems, but the exact causes of the phenomenon of spontaneous emulsification were, as yet, not clearly understood. Even the simplest of catalytic reactions was still under active consideration, in spite of a wealth of experimentation spread over the last 30 years.

The president said that matter in the boundary state was organised, and as a result of such organisation many striking co-operative effects were found. Living matter was likewise organised, but in addition was at its simplest in a state of dynamic equilibrium, and more usually in disequilibrium. It remained for the future to study disequilibrium in more detail. A start had been made in the study of chemical reaction at intephases and transport into and out of the boundary layers.

Measuring Wall Thickness from One Side

Dawe Instruments Employ Ultrasonic Equipment

IN industry there are very many cases where it is required to measure wall thickness when only one surface is available. The use of such non-destructive tests as the measurement of the back-scattering of radioactive sources has provided only a partial solution to the problem. Even where the material is thin enough to enable β-radiation to be employed (and this means a very thin sheet in the case of metals), the instrument must be calibrated by using a similar piece of material of known thickness, and an absolute measurement of thickness cannot be obtained.

For virtually all metals, however, a γ source must be used to obtain sufficient penetration. Unfortunately, γ-rays, having high energies, are also dangerous to operators working in the vicinity, so that heavy shielding and fairly elaborate safety precautions must be employed. Furthermore, the thickness of metals which can be handled by existing isotopes is limited. The radiographic use for both natural and artificial radioactive isotopes recommended by the Atomic Energy Research Establishment is for the penetration of steel up to only 6-in. thick.

Two Methods Available

The ultrasonic methods of measuring wall thickness do not suffer from the above disadvantages, and can be employed for virtually any wall thicknesses of both metallic and non-metallic substances likely to be met with commercially. Two such methods are available, namely: the ultrasonic pulse method, and the ultrasonic resonance method. The first of these operates on a somewhat similar theory to a radar or 'Asdic' set in that the time for a pulse to be transmitted through the material, to be reflected at the far surface and to return is measured. If the velocity of sound in the medium is known, the wall thickness can readily be obtained.

When using this pulse method, however, the measurement of wall thicknesses below, say, $\frac{1}{4}$ in. becomes inaccurate and difficult. The trace produced by the pulse method is difficult to interpret and needs a very high degree of skill to obtain consistent results.

The ultrasonic resonance method has the same advantages as the pulse method in accuracy, simplicity of operation and absolute calibration, and it has the additional advantage that it requires no measurement of time, so that the whole instrument can be made simple and robust. The Dawe Ultrasonic Thickness Gauge, which works on this principle, is self-contained, since it works from dry batteries housed within the 12 in. × 14 in. × 8 in. case. The weight of the instrument is 23 lb., so that it can be slung over the operator's shoulder and carried about.

Small Size Useful

This small size is useful for all types of application but more particularly for pressure vessels. The instrument will pass through a porthole of 18 in. diameter, such as is often found on this type of vessel. The absence of any cathode-ray tube is a great advantage for many grades of work, and the absence of a connection to an electrical mains means that these gauges can be slung down the side of a ship, over all types of terrain to inspect pipelines, and the like.

The theory of the ultrasonic resonance method is, briefly, that a vibrating quartz crystal is placed in contact with the available face of the material under test. By frequency-modulating the electronic oscillator which drives the quartz crystal, a signal is produced at a fundamental frequency and at harmonics of this fundamental frequency. The frequency at which the crystal is driven (always below the natural frequency of the crystal itself) can be altered by turning a calibrated dial on the instrument. The crystal injects an ultrasonic wave into the material, through which it is then transmitted in the form of a narrow beam. On reaching the far (and inaccessible) surface, the wave is reflected, at least in part, backwards along the way it came, since sound waves are reflected by interface surfaces separating two materials having different acoustical impedances.

Now, if the whole path—comprising twice the wall thickness—coincides with a whole number of wavelengths of the ultrasonic wave, the transmitted and reflected waves

will find themselves in phase. The result of this will be a relatively large increase in the amplitude of the wave in the material and of the sound in the headphones of the thickness gauge, or in the reading of the meter mounted on the instrument. This condition is fairly critical and the exact position of resonance can be obtained accurately. For the special case of the fundamental frequency the pathlength will be *equal* to the wavelength of the wave. Since fundamental frequency of wave (f_1) x wavelength (γ) = velocity of sound in the medium (V), the following relation holds true:—

$$\text{Wall thickness} = \gamma/2 = \frac{V}{2.f_1}$$

It is now possible to see why an ultrasonic wave is used rather than an audio wave. If a high value for f_1 cannot be obtained, the wall thickness it will be possible to measure will not be small enough.

If we assume that the highest frequency which can be detected by the human ear is 20,000 cycles per second, and that the velocity of sound in steel is 19,300 ft./sec., then the *thinnest* wall thickness that can be measured using the fundamental of an audio wave is:

$$\tfrac{1}{2} \times \frac{19{,}300}{20{,}000} \times 12$$

or roughly 6 in., and correspondingly thicker walls using the harmonics. By using ultrasonic frequencies of 20 megacycles/sec., and higher, it is possible to measure thickness down to 0.005 in., or less, and obtain much greater accuracy—the normal commercial limit being in the region of 1/16 in., since many materials absorb energy very rapidly at these high frequencies.

In addition, audio frequency crystals would be large and expensive.

The lowest fundamental frequency available when using the Dawe Ultrasonic Thickness Gauge is about 800,000 cycles/sec., so that all wall thicknesses over 0.145 in. in steel and *pro rata* in other materials are measured by the aid of harmonics. Here the procedure is to rotate the dial until the sound in the headphones indicates that a maximum signal has been reached. A record is then taken of the frequency. The dial is then rotated again until the next maximum sound level is indicated in the headphones. By subtraction of these two frequencies the fundamental frequency is obtained.

A series of tests were carried out at G. A. Harvey & Co. (London), Ltd., Woolwich Road, London, S.E.7 (the manufacturers of oil refinery and chemical plant) on a test block with wall thicknesses of known value. The thicknesses ranged from 1/16 in. up to 3½ in., and the greatest deviation anywhere in the range from the figure given by a micrometer was 1 per cent. Guaranteed accuracy is actually ± 3 per cent. Although reference was made to the fundamental formula, this is not necessary in practice, since the instrument has a built-in computer which eliminates the need for any calculation by the operator.

The ultrasonic thickness meter has the advantage that it tends to record low on surfaces marred by rust and the like. In fact, when measuring, say, against a scale-covered surface, the thickness of the scale is not measured, although there is usually a reduction in signal strength which does not affect the accuracy of the measurement. Also, paint has no effect on the reading.

Preparing Surfaces

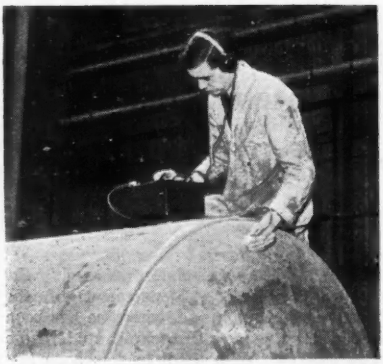
For really rough surfaces, such as are met with in shipbuilding, a small amount of surface preparation by filing or grinding is required to provide a suitable surface to which the crystal unit can be applied. A thin film of oil, grease, glycerine or vaseline, however, provides a sufficiently good ultrasonic coupling between the crystal and the work for all normal purposes. Special crystal units can be supplied for tests on curved surfaces.

The velocity of sound in steel is substantially independent of the chemical composition of the steel, previous heat treatment, internal stresses, temperature, etc., and does not vary more than about 1 per cent over all ordinary commercial steels. A similar constancy holds good for other materials such as copper, nickel and aluminium. Alloys such as brass and cast iron are, however, much more variable and here it is usual to carry out a preliminary test to set the computing scale before taking measurements. So far only metals have been considered, but measurements can equally well be taken on glass or on plastics. The thickness range of the instrument for steel is roughly from 1/16 in. to 12 in., and proportionately for other materials.

Some applications of the Dawe Ultrasonic Thickness Gauge have already been mentioned above. Ship repairing provides an example of a particularly large economy since, in the past, it has been necessary to resort to elaborate measures, such as drilling holes in plating, to provide access to the second side. After measuring the thickness of the plate to check that excessive corrosion has not taken place, the test holes must be plugged. On tankers up to 1,200 drillings may be required, involving some eight working days.

The chemical, petroleum and gas industries are all cases where the previously mentioned independence from a mains supply and the ready portability of the instrument are of outstanding value. This thickness gauge can be used alike in the works of a manufacturer of chemical equipment to measure the thickness at the centre of large dished and flanged ends, or in the middle of a desert to check the corrosion of an oil pipeline.

One measurement which has occasioned great trouble in the past can now be obtained in a matter of minutes with an accuracy several times greater than previously. This application concerns the variation in the thickness of pipes at bends. Not unnaturally, pipe walls on the outside of bends tend to be subject to a considerable reduction. It is normally impossible to obtain a direct measurement of wall thickness due to obstruction from the bend, while the setting of callipers to transfer the wall thickness



Checking the thickness of one end of a receiving vessel using a Dawe Ultrasonic Thickness Gauge

Due to its shape it is difficult to measure the wall thickness of this chrome-clad spun head by ordinary mechanical gauging

for convenient measurement outside is also frustrated by the increase in wall thickness on either side of the bend itself. Special callipers, pivoted at the centre, where a reading is obtained at the other end inversely proportional to the wall thickness are not only cumbersome but must be calibrated (i.e. are not direct-reading) and are inevitably inaccurate due to play at the pivot. Sectioning has, therefore, been the only effective recourse, but this is destructive and is not only expensive but also means that only a proportion of all work can be tested.

Much chemical equipment, such as fractionating columns, gas holders, oil storage tanks, etc., are high and bulky and a small instrument which can be carried up ladders and along cat walks is particularly valuable. A final point which will commend the Dawe Ultrasonic Thickness Gauge to engineers is that it can be applied without shutting the plant down. By this means a foreknowledge of possible weakness can be obtained before it actually becomes serious.

As has been intimated above, this gauge is very simple to operate, but any queries regarding operation and maintainance will gladly be dealt with by Dawe Instruments, Ltd., 83 Piccadilly, London, W.1, who are producing this equipment under licence from Branson Instruments Inc., and the General Motors Corporation of America.

SCI Crop Protection Panel

Members Hear Talk on Locust Control

THE annual general meeting of the Crop Protection Panel of the Society of Chemical Industry was held in London on 1 April, under the chairmanship of Mr. W. E. K. Piercy.

In his report, the secretary said that membership had increased this year by 45 to a total of 208, and he hoped that this rate would be kept up. A set of Rules for the panel had been drawn up and approved. Six successful meetings had been held, including a full-day symposium. The summer meeting, still to take place, would be held on Wednesday, 4 June, and would be in the form of a visit to the Hawthorndale Laboratories of Imperial Chemical Industries, Ltd.

Officers Elected

There was a vacant seat on the committee and on the proposal of Dr. E. Holmes, seconded by G. L. Baldit, Mr. W. E. K. Piercy was unanimously elected to the vacancy. The committee for 1952/53 would be:—

Chairman: Dr. R. A. E. Galley (Agricultural Research Council, London, S.W.1); *hon. treasurer*: W. H. Read (Research Station, Cheshunt); *hon. recorder*: Dr. E. E. Turtle (Ministry of Agriculture and Fisheries, Tolworth); *hon. secretary*: G. L. Baldit (Plant Protection, Ltd., Yalding); *members*: N. K. Smith (Murphy Chemical Co., Wheathampstead), Dr. J. R. Booer (F. W. Berk & Co., London), and W. E. K. Piercy (Albright & Wilson, London).

Attention was drawn to the Third International Congress of Crop Protection to be held in Paris in September.

Locusts and Insecticides

Following the conclusion of official business a paper entitled 'Locusts: Why Use Insecticides?' was delivered by Dr. D. L. Gunn of the Anti-Locust Research Centre.

Discussing the choice of chemical, the speaker said that, generally, phytotoxicity was unimportant but toxicity to spraying personnel was a serious problem. Parathion was the best locusticide known, but, owing to its high mammalian toxocity, it was very dangerous to handle. DNC was quick acting and selective and was most favoured by Dr. Gunn. It was also very toxic but less so than parathion.

The γ-isomer of BHC was a good contact insecticide and fairly persistent. It was much less toxic to mammals than DNC. However, its high cost tended to make it uneconomic. Chlordane, toxaphene and aldrin were slow-acting stomach poisons and of little use except against static swarms.

Sir George Beilby Awards

Recipients Both Study Metals

THE administrators of the Sir George Beilby Memorial Fund, representing the Institute of Metals, the Royal Institute of Chemistry and the Society of Chemical Industry, have decided to make two awards, each of one hundred guineas, from the Fund for 1951.

These awards have been made to: Kenneth Henderson Jack, M.Sc. (Dunelm), Ph.D. (Cantab) F.R.I.C., in recognition of his experimental contributions to the study of interstitial alloys, especially in the iron-nitrogen and iron-carbon-nitrogen systems; and William Arnold Wood, D.Sc. (Manchester), F.Inst.P., in recognition of his experimental contributions to knowledge of the mechanism of deformation of metals.

Awards from the Fund are made to British investigators in science as a mark of appreciation of distinguished work, particularly in such fields as fuel economy, chemical engineering and metallurgy, in which Sir George Beilby's special interests lay. In general, the awards are not applicable to the more senior investigators but are granted as an encouragement to relatively young men who have done independent work of exceptional merit over a period of years.

Dr. Jack is a lecturer in inorganic chemistry at King's College, Newcastle-upon-Tyne, and recent work of his and his associates is concerned with the cobalt-carbon-nitrogen system and with the ageing of nitrogen ferrites.

Dr. Wood is an associate professor in the Metallurgy Research Department of the University of Melbourne, where he has been directing the work of research students in metal studies. With them he has been responsible in particular for new observations on the mechanisms by which metals deform at elevated temperatures.

HOME

450 Years' Service

Long service presentations were made at Runcorn on 15 April to 16 employees of the General Chemicals Division of Imperial Chemical Industries, Ltd., whose aggregate service ranging from 20 to 40 years totalled 450 years.

Rockefeller Grants

Grants to British Institutions totalling nearly £90,000 were announced in the quarterly report of the Rockefeller Foundation in New York on 20 April. Included among these were grants of £17,857 to the Medical Research Council of Great Britain for fellowships in medicine and £5,357 to the University of London for the support of research on the organic chemistry of biologically important molecules.

Laboratory Moved

The research laboratory of L. Oertling Limited, the internationally known balance and weights manufacturers, has been moved to Cray Valley Road, St. Mary Cray, Kent. The move took place on Tuesday, 15 April.

KID Exemptions

Under the heading synthetic organic chemicals, analytical reagents, other fine chemicals and chemicals manufactured by fermentation processes, the following items have been exempted from Key Industry Duty for the period 22 April to 18 August: *tert*-butyl perbenzoate (a butyl ester); diethylene glycol-monoethyl ether acetate (an ethylene glycol ether-ester); *o*-phenylenediamine; urea; hydrogen peroxide. The Order is the Safeguarding of Industries (Exemption) (No. 3) Order, 1952, and is published as Statutory Instruments, 1952, No. 766 (HMSO, 2d.).

Fertiliser Imports Freed

The Ministry of Materials has announced that after 30 June 1952, the importation on public account of fertilisers and fertiliser raw materials (phosphate rock, potash salts, superphosphates and basic slag) will cease; and the trade will be returned to the fertiliser manufacturers and merchants. Import licences will be required thereafter, and a further announcement on this subject will be made after discussions now proceeding with industry have been completed. Statutory control of the prices of most fertilisers will continue.

Order Books Full

Because it is essential to concentrate on production, and as its order books are full and materials are scarce, Tube Investments, Ltd., has decided not to exhibit at the British Industries Fair, Castle Bromwich, this year. This decision was taken mainly because it was not wished to disappoint overseas buyers who would not have been able to to place orders if the group had continued to exhibit. There was no intention of permanently discarding a display at the BIF.

Golfing Chemists

The annual golf meeting of the London and South-Eastern Counties Section of the Royal Institute of Chemistry will be held at the Shirley Park Golf Club, East Croydon, on Wednesday, 21 May. The Medal round for the Government Laboratory Cup will be held in the morning and a foursomes competition in the afternoon. Members, whether regular or only occasional players, are invited to attend this function.

Combating Inflation

The major effort being made by his company in the fight against inflation was referred to by Sir Ewart Smith, technical director of Imperial Chemical Industries, Ltd., when he presented long-service awards to 282 employees of the Metals Division at Witton on 18 April. Since 1938 the general price index of wholesale commodities had gone up by 208 per cent, said Sir Ewart, but the weighted selling price of all I.C.I. products had risen by only 82 per cent. It was the workers' responsibility to help to produce more, he declared.

Tungsten Mining in Cornwall

Tungsten ore is being prospected for in East Cornwall. Two mining developments which are taking place there, one at Trefartha, near North Hill, and the other at Luckett, near Callington, are being sponsored by New Consols, Ltd., and the Wolfram Prospecting Syndicate, Ltd. An old mine is also being reopened at Teebartha, the ore of which contains both tin and wolfram. The company is also reported to be prospecting for wolfram on Dartmoor.

PERSONAL

MR. REX FURNESS, chief research chemist at Joseph Crosfield and Sons, Ltd., Warrington, for more than 25 years, who has retired at the age of 60, has been presented with a silver salver by the firm's chairman, Mr. P. A. W. Came, and the directors. His colleagues on the management staff presented him with a portable wireless set and a chiming clock, and from his fellow workers in the research laboratory he received an electric razor and a pipe.

JOHN H. RAMSAY, of Messrs. T. and H. Smith, Ltd., chemical manufacturers, Blandfield Works, Edinburgh, has been appointed chairman of the manufacturers' section of the Edinburgh Chamber of Commerce and Manufacturers, for the ensuing term.

MR. R. CAMPBELL WILLIAMS has resigned as Technical Manager to New Metals & Chemicals Ltd., after holding the position for many years. Mr. Williams has started a private consulting practice at 16 Robins Court, Kings Avenue, London, S.W.4, and will specialise in the rarer metals and chemicals.

PROFESSOR E. C. DODDS, M.V.O., M.D., D.Sc., Ph.D., F.R.I.C., Courtauld Professor of Biochemistry at the University of London and Director of the Courtauld Institute of Biochemistry at the Middlesex Hospital, London, has been awarded the Harben Medal under the terms of the Harben Trust for 'eminent services rendered to the public health' by the Council of the Royal Institute of Public Health.

Following the election of the Duke of Edinburgh as the first Honorary Fellow of the Royal Institute of Chemistry, the Council recently elected the following as Honorary Fellows: SIR HENRY H. DALE, O.M., G.B.E., M.A., M.D., F.R.C.P., F.R.S.; SIR HAROLD HARTLEY, K.C.V.O., C.B.E., M.C., M.A., D.Sc., F.R.S.; THE RT. HON. LORD MCGOWAN, K.B.E., Hon.LL.D., Hon.D.C.L.; RICHARD BERTRAM PILCHER, O.B.E., F.C.I.S.; PROFESSOR ARNE TISELIUS, D.Sc., Hon.M.D.; and SIR HENRY TIZARD, G.C.B., A.F.C., M.A., F.R.S.

LORD PROVOST SIR VICTOR WARREN, who vacates office in Glasgow within a few weeks will return to active participation in the chemical trade as manager for Scotland for I.C.I. Ltd.

PROFESSOR JOHN THEODORE HEWITT, F.R.S., Professor Emeritus of Chemistry, Queen Mary College, was among those whose election to honorary fellowship of the Imperial College of Science and Technology was announced on 16 April.

At the annual general meeting of The Chemical Society held in Dublin on 16 April, the following elections were declared: President: PROFESSOR C. K. INGOLD; Vice-Presidents: PROFESSOR E. L. HIRST and SIR JOHN SIMONSEN; Ordinary Members of Council: DR. D. H. R. BARTON (London), DR. N. CAMPBELL (Edinburgh), DR. J. CHATT (Welwyn), DR. S. J. GREGG (Exeter), DR. F. B. KIPPING (Cambridge), DR. E. A. MOELWYN-HUGHES (Cambridge), PROFESSOR A. ROBERTSON (Liverpool), and DR. M. A. T. ROGERS (Manchester). SIR ERIC RIDEAL the retiring president, becomes a vice-president.

Obituary

It is with regret that we announce the death of MR. REGINALD HEWITT who was for many years industrial relations officer of the Clayton Aniline Company and a member of the executive board of the Chemical and Allied Employers' Federation and the Joint Industrial Council.

In 1936 he helped to form a new employers' organisation to restore negotiating machinery in the industry; this was the Association of Chemical Employers of which he was secretary from 1936 to 1944. With the unions concerned Mr. Hewitt helped to form four new joint industrial councils from 1936 onwards—for heavy chemicals, drug and fine chemicals, plastics and glue and gelatine—and was secretary of each until 1944.

MR. A. C. WARWICK, a joint managing director of Sterns, Ltd., refiners of petroleum products, died recently.

OVERSEAS

Canadian Institute of Chemistry

The 35th annual conference and exhibition of the Chemical Institute of Canada will be held in Montreal from 2-4 June, and more than 1,000 chemists and chemical engineers are expected to attend. The Chemical Institute of Canada Medal will be presented and the Westman Memorial Lecture will be delivered. Dr. H. G. Thode, principal of the Department of Chemistry at McMaster University, is this year's president.

Joint Company Formed

A new joint company is to be formed in the Belgian Congo and Ruandi-Urundi by Solvay and Co. and Union Chimique Belge, S.A. The new company will be called Compagnie Chimique et Industrielle du Congo (CHIMINCO), provided this name is accepted by Royal decree. Union Chimique Belge's present subsidiary in the Belgian Congo is called Société Africaine de l'Union Chimique Belge (Africhimic).

May Supply Cortisone Materials

Brazil may become an important source of raw materials for cortisone if satisfactory results are obtained from research on Brazilian yams recently begun by the U.S. Department of Agriculture. The yams are reported to be very similar to those already being used in Mexico.

Japanese Celluloid Exports

Exports of celluloid and products for 1951 reached a value of $2,619,000 or an increase of $507,000 over the previous year, according to reports of the Japan Celluloid Manufacturers Association. Of these exports 30 per cent were taken by the U.S.A., the next largest recipients being Brazil, the Netherlands, Belgium and Hong Kong.

Jules Verne Still Attracts

A rocket expert lecturing in the U.S.A. on space satellites and the means of getting them into position, expected a crowd of 200 to turn up. To his surprise, 4,000 came and another 3,000 were turned away. Among his opinions were that the fuel used to drive a rocket 1,075 miles above the earth would be hydrazine and nitric acid, and that the project could be realised in ten years at a cost of $4,000,000,000. The lecturer was Wernher von Braun, leading German rocket scientist during the last war.

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Canadian Oil Boom Continues

Some 200 oil-drilling rigs are reported to be operating in Alberta and British Columbia at present, a 75 per cent increase over the previous year. Oilfields in these two provinces can now produce 50,000,000 barrels a year. Present refining capacity in Canada is estimated at 389,000 barrels a day.

£8,000,000 Lubricating Oil Plant

Latest addition to Shell's new and rapidly expanding refinery at Cardon on the Paraguana Peninsula, Northern Venezuela, is a new £8,000,000 plant, now completed, which will produce over 100,000 tons annually of high quality lubricating oils. The plant comprises the following units: propane deasphalting; furfurol extraction; M.E.K./benzole de-waxing; and clay contracting. The intake will consist of Venezuelan reduced crude oils, both of the mixed base (paraffinic) and the naphthenic type.

Gasification Tests

The Syndicat des Charbons de la Lukuga, which contemplates erecting a synthetic oil factory (Fischer-Tropsch) in the Belgian Congo, is now carrying out the first gasification tests with coal from the Lukuga Basin, near Albertville, on Lake Tanganyika. Several hundred tons of this coal have been sent to Belgium where it will be decided whether it is suitable for gasification and what would be the most suitable process. The members of the syndicate are Union Chimique Belge, who took the initiative and who own 40 per cent, Géomines, who own the deposits (20 per cent), Comité Spécial du Katanga (20 per cent) and the Société Générale de Belgique (20 per cent).

Gallium^{67} Decay Scheme Determined

Research workers at Oak Ridge National Laboratory, U.S.A., have recently computed the decay scheme for gallium^{67}, a cyclotron-produced isotope which their medical division has been investigating. It is believed that a much higher dose of radiation may be delivered to a tumour with gallium^{67} than with gallium^{72}, which is used at present and has a half-life of only 14.3 hours. Gallium^{67} has a half-life of 3.24 days and is said to have a less energetic gamma-ray emission.

RIC Summer Visits

Harwell and Wye on Programme

PRELIMINARY details of nine Summer visits arranged for Fellows, Associates and Registered Students, have been announced by the London and South-Eastern Counties Section of the Royal Institute of Chemistry.

The first visit on 23 May will be to the Atomic Energy Research Establishment at Harwell. The maximum number possible for this party is 30. The Ministry of Supply will arrange transport from Didcot station to meet the 9.15 a.m. train from Paddington, and have also agreed to supply luncheon.

Paint Factory Tour

A tour of the paint factory of Associated Lead Manufacturers, Ltd., Millwall, is the next trip, scheduled for 28 May. The visit will begin at 2.45 p.m. and end at approximately 5 p.m. Tea will be provided. (Maximum 30.)

On 11 June members will have the opportunity of inspecting the research laboratories of the Distillers' Company, Ltd., Great Burgh. It is proposed to begin the tour at 1.30 p.m. and end it at 5 p.m. (Maximum 20).

The visit to the factory and laboratories of Horlicks, Ltd., Slough, Bucks., on 12 June will be held jointly with the London Section of the Society of Chemical Industry, and will begin about 6.30 p.m. following light refreshments.

Another joint tour, with the Agriculture Group of the SCI, will be to the John Innes Horticultural Institution at Bayfordbury, on 14 June. If there is sufficient support it may be possible to arrange a coach. The tour of the institution would begin about 11 a.m., and it is hoped to provide luncheon and tea at a cost of about 10s. (Maximum: 25).

Laboratories of the Water Pollution Research Laboratory to be visited on 17 June are situated at Garston. Further details will be supplied later to successful applicants (maximum 50).

On the visit to Sheet Glass, Ltd., fixed for 25 June, it is suggested that members taking part should travel on the 12.35 p.m. train from Victoria, arriving at Queensborough station at 2.10 p.m. The return train will arrive at Victoria about 7.0 p.m. (Maximum: 25).

The tour of International Alloys, Ltd., Aylesbury, on 1 July, will begin at 2.30 p.m., and tea will be provided. (Maximum: 25).

The last visit on 12 July will be to Wye Agricultural College. Visitors should arrive by 12.45 p.m., when luncheon will be provided (3s. 6d. per head). Afterwards there will be a lecture by Professor R. L. Wain on the work of the Research Station and a visit, followed by a demonstration and field inspection. Tea will be available at 4.30 p.m. (2s. 6d. per head). A few places may be available for friends. (Maximum: 60).

It is pointed out that members are not expected to apply for visits to competitive organisations without having first ascertained from the management concerned that their presence is acceptable.

Applications should be made to the hon. assistant secretary, F. C. Hymas, Spratt's Patent, Ltd., Morris Road, London, E.14, not later than 6 May.

CWU Wants Increases

A RESOLUTION criticising Government policy and calling for substantial wage increases for those employed in the chemical industry was carried unanimously at the quarterly meeting of the national executive council of the Chemical Workers' Union which ended on Sunday, 20 April. Blaming the 'immediate effects of the Government's economic and financial policy' for the rise in the cost of living, the resolution protested against 'a gradual return to the economic fallacies of the inter-war years based on dearer money, restricted credit, long-term deflationary policies, and compulsion through unemployment, short time, and insecurity'.

The resolution also complained of the 'gross mishandling of the Commonwealth economic conference which led to arbitrary cuts in sterling imports' and called for an expansion of trade with the Commonwealth and Asiatic countries, based on long-term barter arrangements.

Readers should remember that the Union represents a very small proportion of the workers employed in the British chemical industry.

Publications & Announcements

MEANS for measuring the suction of moisture held in soil and other porous materials are described in Road Research Technical Paper No. 24, published for the DSIR, Road Research Laboratory. Detailed laboratory procedures are described for the nine principal methods of suction measurement. These are: the suction plate, tensiometer, centrifuge, pressure membrane, consolidation, freezing point depression, vacuum desiccator, sorption balance, and electrical resistance methods. Besides engineering problems these methods may be applied to the study of soil in agriculture and to the behaviour of porous materials used in the ceramics industry. 'The Suction of Moisture Held in Soil and Other Porous Materials' (HMSO, 2s.).

* * *

AN ATTRACTIVE brochure on the Nichols Freeman Flash roaster for the roasting of pyrites and other sulphur-bearing minerals for sulphuric acid production has recently been issued by Simon-Carves, Ltd., of Stockport, Cheshire. This describes the principles and operation of the flash roaster, giving performance figures, photographs and diagrams of the plant. All the text is in English, French, Italian and German.

* * *

FLAMMABILITY limits of gases and vapours in air or oxygen are listed in *Bulletin* 503, 'Limits of Flammability of Gases and Vapours,' issued by the U.S. Bureau of Mines and now obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. (40 cents a copy). The bulletin is the fourth publication on the subject to be prepared by Dr. H. F. Coward, late director of Safety in Mines Research, Ministry of Fuel, Great Britain, and G. W. Jones, chief of the Gaseous Explosions Branch at the Central Experimental Station of the Bureau of Mines, U.S. Department of the Interior, Pittsburg, Pa. The two scientists began research on flammability limits in April 1925 under a co-operative agreement between the Safety in Mines Research Board of Great Britain and the U.S. Bureau of Mines. The first publication in 1928 listed the flammability limits of 26 substances, in contrast to the 155 given in the new issue.

A HIGHLY successful piece of international co-operation—the flame radiation trials at Ijmuiden, Holland—is described by Max Davies in an article 'Flame Radiation and Furnace Efficiency' in the current issue of *Murex Review* (Vol. 1, No. 10), published by Murex, Ltd., Rainham, Essex. The trials are being carried out on a specially built experimental furnace at the works of the Royal Netherlands Steel Company under a team of scientists from France, Great Britain, Holland, and Sweden.

* * *

THERMOMETERS are the sole subject of a new catalogue brought out recently by H. J. Elliott Limited, of 'E-Mil' Works, Treforest, Glam. Attractively presented, this gives comprehensive details of the many different types of thermometer produced by the firm, as well as hints on their care and adjustment and a temperature conversion table. Also included is a section on works certified thermometers and one on special thermometers which can be constructed by the firm to customers' specifications for particular purposes. The company have produced a new enamel for the backing of thermometers, coloured yellow, which, they say, makes for easier reading. They produce three main groups of thermometers—laboratory and chemical, chemical and general purpose, and industrial thermometers for oil and petroleum.

* * *

THE result of over 20 years of continuous development and improvement are embodied in the brochure of the Westbrook Lanolin Company, a subsidiary of Woolcombers Ltd., of Bradford. This company specialise in the production of 'Golden Dawn' Pharmaceutical Lanolin, in several grades, which is extensively used in ointments, medicinal products, cosmetics, etc. The methods of grease extraction from the merino wool used are entirely physical and ensure that the extracted grease is in a purer and more natural state than acid-extracted greases. The brochure gives details of uses of the grades of lanolin made by the company, as well as their specifications and those of the wool wax alcohols, wool grease, fatty acids and other products manufactured by the company.

British Chemical Prices

LONDON.—The movement of supplies to the consuming industries has largely been against contracts and new business has been on a small scale. The reduced activity so far has had little effect on prices, which remain steady at recent levels. The volume of overseas inquiry remains fairly good.

There has been nothing of fresh importance to record in the coal tar products market and as elsewhere, activity is more concerned with contract deliveries than in the placing of new orders.

MANCHESTER.—The demand for a wide range of heavy chemicals used in the textile and allied industries continues on a reduced scale in consequence of the trade depression in the cotton and rayon sections and the effect of this has been strongly in evidence on the Manchester market during the past week. In most other directions, however, there has been a fair flow of replacement business and delivery specifications against contracts have been circulating steadily. Prices generally are on a steady to firm basis. Fertiliser materials are being taken up in fair quantities. In the tar products market new bookings are not coming along so freely, though supplies are moving steadily against orders already placed.

GLASGOW.—From reports received, manufacturers as a whole have enjoyed an increased demand for industrial chemicals and the week has closed on a very firm note. From the orders on hand, merchants and manufacturers alike are assured of a busy time for at least the next period and it is to be hoped that this trend continues. With regard to export, there has been a slight falling off but no doubt business will pick up again fairly soon.

General Chemicals

Acetic Acid.—Per ton : 80% technical, 1 ton, £110 ; 80% pure, 1 ton, £116 ; commercial glacial 1 ton, £130 ; delivered buyers' premises in returnable barrels ; in glass carboys, £7 ; demijohns, £11 extra.

Acetic Anhydride.—Ton lots d/d, £166 per ton.

Acetone.—Small lots : 5 gal. drums, £145 per ton ; 10 gal. drums, £135 per ton. In 40/50 gal. drums less than 1 ton, £115 per ton ; 1 to 9 tons, £114 per ton ; 10 to 49 tons, to £113 per ton ; 50 tons and over, £112 per ton.

Alcohol, Industrial Absolute.—50,000 gal. lots, d/d, 4s. 7½d. per proof gallon ; 5000 gal. lots, d/d, 4s. 8½d. per proof gal.

Alcohol, Diacetone.—Small lots : 5 gal. drums, £204 per ton ; 10 gal. drums, £194 per ton. In 40/45 gal. drums : less than 1 ton, £174 per ton ; 1 to 9 tons, £173 per ton ; 10 to 50 tons, £172 per ton ; 50 to 100 tons, £171 per ton ; 100 tons and over, £170 per ton.

Allyl Alcohol.—Less than 40 gals., 3s. 10½d. per lb. ; 40 gal., 3s. 6½d. per lb. ; 2 to 5 40 gal. drums, 3s. 4½d. per lb. ; 1 ton and over, 3s. 2½d. per lb.

Alum.—Loose lump, £17 per ton, f.o.r. MANCHESTER : Ground, £17 10s.

Aluminium Sulphate.—Ex works, £11 10s. per ton d/d. MANCHESTER : £11 10s.

Ammonia, Anhydrous.—1s. 9d. to 2s. 3d. per lb.

Ammonium Bicarbonate.—2 cwt. non-returnable drums ; 1 ton lots £47 per ton.

Ammonium Chloride. — Grey galvanising, £31 5s. per ton, in casks, ex wharf. Fine white 98%, £23 12s. 6d. to £26 5s. per ton. See also Salammoniac.

Ammonium Nitrate.—D/d, £18 to £20 per ton.

Ammonium Persulphate. — MANCHESTER : £6 2s. 6d. per cwt. d/d.

Ammonium Phosphate.—Mono- and di-, ton lots, d/d, £93 and £91 10s. per ton.

Antimony Sulphide.—Golden, d/d in 5 cwt. lots as to grade, etc., 2s. 6½d. to 3s. 7½d. per lb. Crimson, 4s. to 5s. 4½d. per lb.

Arsenic.—Per ton, £59 10s. nominal, ex store.

Barium Carbonate.—Precip., d/d ; 2-ton lots, £35 5s. per ton, bag packing.

Barium Chloride.—£44 10s. 2 ton lots d/d bags.

Barium Sulphate (Dry Blanc Fixe).—Precip., 4-ton lots, £41 per ton d/d ; 2-ton lots, £41 5s. per ton d/d.

Bleaching Powder.—£21 per ton in casks (1 ton lots).

Borax.—Per ton for ton lots, in free 140-lb. bags, carriage paid: Anhydrous, £59 10s. ; in 1-cwt. bags; commercial, granular, £38 10s. ; crystal, £42 ; powder, £43 ; extra fine powder, £44 ; B.P., granular, £48 10s. ; crystal, £51 ; powder, £52 ; extra fine powder £53.

Boric Acid.—Per ton for ton lots in free 1-cwt. bags, carriage paid : Commercial, granular, £68 ; crystal, £76 ; powder, £73 10s. ; extra fine powder, £75 10s. ; B.P., granular, £81 ; crystal, £88 ; powder, £85 10s. ; extra fine powder, £87 10s.

Butyl Acetate BSS.—£224 per ton, in 10-ton lots.

Butyl Alcohol BSS.—£206 per ton, in 10-ton lots. 10 to 49 tons £188 per ton.

***sec.* - Butyl Alcohol.**—5 gal. drums £189 ; 40/45 gal drums : less than 1 ton £169 per ton ; 1 to 10 tons £168 per ton ; 100 tons and over £165 per ton.

***tert.* - Butyl Alcohol.**—5 gal. drums £195 10s. per ton ; 40/45 gal. drums : less than 1 ton £175 10s. per ton ; 1 to 5 tons £174 10s. per ton ; 5 to 10 tons, £173 10s. ; 10 tons and over £172 10s.

Calcium Chloride.—70/72% solid £9 12s. 6d. per ton, in 4-ton lots.

Chlorine, Liquid.—£28 10s. per ton d/d in 16/17-cwt. drums (3-drum lots).

Chromic Acid.—2s. 0½d. to 2s. 0¾d. per lb., less 2½%, d/d U.K.

Citric Acid.—1 cwt. lots, 218s. cwt. 5 cwt. lots, 213s. cwt.

Cobalt Oxide.— Black, delivered, 13s. per lb.

Copper Carbonate. — MANCHESTER : 2s. 8d. per lb.

Copper Sulphate.—£107 17s. 6d. per ton f.o.b., less 2%, in 2-cwt. bags.

Cream of Tartar.—100%, per cwt., about £11 12s. d/d.

Ethyl Acetate.—10 tons and upwards, d/d, £174 per ton.

Formaldehyde.—£35 per ton in casks, according to quantity, d/d.

Formic Acid.—85%, £82 5s. in 4-ton lots, carriage paid.

Glycerine.—Chemically pure, double distilled 1,260 s.g. £14 19s. per cwt.
Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hydrochloric Acid.—Spot, 12s. to 16s. per carboy d/d, according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. to 1s. 2d. per lb.

Hydrogen Peroxide.—27.5% wt. £124 10s. per ton. 35% wt. £156 per ton d/d. Carboys extra and returnable.

Iodine.—Resublimed B.P., 21s. 3d. per lb. in cwt. lots.

Iodoform.—25s. 4d. per lb. in cwt. lots.

Lactic Acid.—Pale tech., 44 per cent by weight £122 per ton ; dark tech., 44 per cent by weight £87 per ton ex works ; Usual container terms.

Lead Acetate.—White : £185 10s. per ton.

Lead Nitrate.—£142 per ton.

Lead, Red.—Basis prices per ton : Genuine dry red lead, £183 10s. ; orange lead, £195 10s. Ground in oil: red, £206; orange, £218.

Lead, White.—Basis prices : Dry English, in 5-cwt. casks, £191 per ton. Ground in oil : English, under 2 tons, £209.

Lime Acetate.—Brown, ton lots, d/d, £30 to £34 per ton ; grey, 80-82%, ton lots, d/d, £34 to £39 per ton.

Litharge.—£183 10s. per ton.

Magnesite.—Calcined, in bags, ex works, £27.

Magnesium Carbonate.—Light, commercial, d/d, £87 15s. ; cwt. lots £97 10s. per ton d/d.

Magnesium Chloride.—Solid (ex wharf), £15 per ton.

Magnesium Oxide.—Light, commercial, d/d, £221 ; cwt. lots £227 10s. per ton d/d.

Magnesium Sulphate.—£12 to £14 per ton.

Mercuric Chloride.—20s. 1d. per. lb. in 28 lb. lots ; smaller quantities dearer.

Mercury Sulphide, Red.—Per lb., from 10s. 3d. for ton lots and over to 10s. 7d. for lots of 7 to under 30 lb.

Methanol.—Pure synthetic, d/d, £28 to £38 per ton.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 7s. 10d. per gal. ; pyridinised 64° O.P. 100 gal., 7s. 11½d. per gal.

Methyl Ethyl Ketone.—5 gal. drums, £179 per ton ; in 40-45 gal. drums, less than 1 ton, £159 per ton ; 50 to 100 tons, £156 per ton ; 100 tons and over, £155 per ton.

Methyl *iso*Butyl Ketone.—5 gal. drums, £219 per ton ; in 40-45 gal. drums, less than 1 ton, £199 per ton ; 50 to 100 tons, £196 per ton ; 100 tons and over, £195 per ton.

Nickel Sulphate.—D/d. buyers U.K. £140 10s. per ton.

Nitric Acid.—£35 to £40 per ton, ex works.

Oxalic Acid.—About £181 per ton, packed in 5-cwt. lots, packed in free 5-cwt. casks.

Phosphoric Acid.—Technical (S.G. 1.500), ton lots, carriage paid, £71 10s. per ton ; B.P. (S.G. 1.750), ton lots, carriage paid, 1s. 3½d. per lb.

Potash, Caustic.—Solid, £98 10s. per ton for 1-ton lots ; Liquid, £37 15s.

Potassium Bichromate.—Crystals and granular, 11¼d. per lb. ; ground, 1s. 0¾d. per lb., standard quantities.

Potassium Carbonate.—Calcined, 98/100%, £116 per ton for 1-ton lots, ex store.

Potassium Chloride.—Industrial, 96%, 6-ton lots, £20 to £22 per ton.

Potassium Iodide.—B.P., 18s. 7d. per lb. in 28 lb. lots.

Potassium Nitrate.—Small granular crystals, 81s. per cwt. ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 7½d. per lb. for 1-cwt. lots ; for 3 cwt. and upwards, 1s. 6½d. per lb. ; technical, £8 3s. per cwt. ; for 5 cwt. lots.

***iso*Propyl Alcohol.**—Small lots : 5 gal. drums, £156 per ton ; 10 gal. drums, £146 per ton ; in 40-45 gal. drums : less than 1 ton, £126 per ton ; 1 to 9 tons, £125 per ton ; 10 to 50 tons, £124 per ton ; 50 to 100 tons, £123 per ton ; 100 tons and over, £122 per ton.

Salammoniac.—Dog-tooth crystals, £72 10s. per ton ; medium, £67 10s. per ton ; fine white crystals, £21 10s. to £22 10s. per ton, in casks.

Salicylic Acid. — MANCHESTER : Technical 2s. 5d. to 2s. 7d. per lb. d/d.

Soda Ash.—58% ex depôt or d/d, London station, £8 17s. 3d. to £10 14s. 6d. per ton.

Soda, Caustic.—Solid 76/77% ; spot, £23 5s. per ton d/d. (4 ton lots).

Sodium Acetate.—£85 to £91 per ton d/d.

Sodium Bicarbonate.—Refined, spot, £12 7s. 6d. per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 9¾d. per lb. ; anhydrous, 11¼d. per lb., net, d/d U.K. in 7-8 cwt. casks.

Sodium Bisulphite.—Powder, 60/62%, £40 per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—£25 per ton d/d in minimum ton lots in 2-cwt. free bags.

Sodium Chlorate.—£87 to £95 per ton.

Sodium Cyanide.—100% basis, 8d. to 9d. per lb.

Sodium Fluoride.—D/d, £4 10s. per cwt.

Sodium Hyposulphite.—Pea crystals £28 a ton ; commercial, 1-ton lots, £26 per ton carriage paid.

Sodium Iodide.—B.P., 20s. 1d. per lb., in 28 lb. lots.

Sodium Metaphosphate (Calgon).—Flaked, loose in metal drums, £123 ton.

Sodium Metasilicate.—£22 15s. per ton, d/d U.K. in ton lots.

Sodium Nitrate.—Chilean Industrial, 97-98%, 6-ton lots, d/d station, £30 15s. per ton.

Sodium Nitrite.—£31 for 1 ton lots.

Sodium Percarbonate.—12½% available oxygen, £8 8s. 4½d. per cwt. in 1-cwt. drums.

Sodium Phosphate.—Per ton d/d for ton lots : Di-sodium, crystalline, £37 10s., anhydrous, £78 10s. ; tri-sodium, crystalline, £39 10s., anhydrous, £75 10s.

Sodium Prussiate.—10d. to 10½d. per lb. ex store.

Sodium Silicate.—£6 to £11 per ton.

Sodium Sulphate (Glauber's Salt).—£8 per ton d/d.

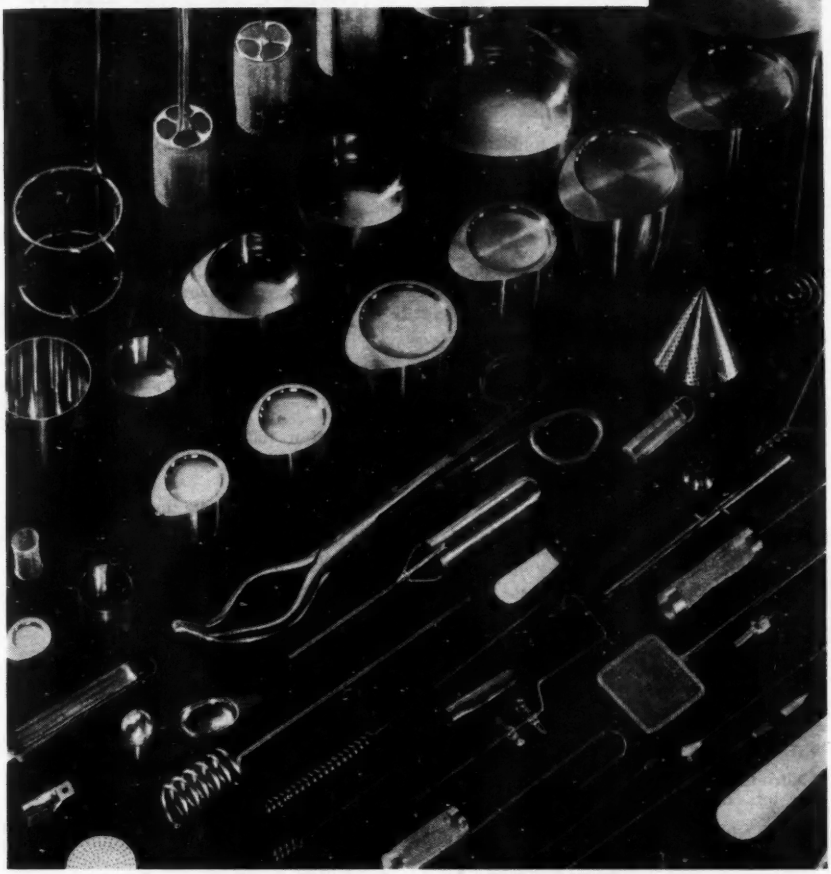
Sodium Sulphate (Salt Cake).—Unground. £6 per ton d/d station in bulk. MANCHESTER : £6 10s. per ton d/d station.

Sodium Sulphide.—Solid, 60/62%, spot. £30 per ton, d/d, in drums ; broken, £30 15s. per ton, d/d, in drums.

Sodium Sulphite.—Anhydrous, £59 per ton ; pea crystals, £37 12s. 6d. per ton d/d station in kegs ; commercial, £23 7s. 6d. per ton d/d station in bags.

Sulphur.—Per ton for 4 tons or more, ground, £22 16s. 6d. to £25 6s. according to fineness.

Platinium Laboratory Apparatus



Our new publication 1710 gives detailed information upon the JMC ranges of standard platinum apparatus and microchemical apparatus, and general advice upon their care and maintenance. Copies of the booklet are available free on request.

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Tartaric Acid.—Per cwt. : 10 cwt. or more, £14.

Titanium Oxide.—Comm., ton lots, d/d (56-lb. /112 lb. bags), £125 per ton.

Zinc Oxide.—Maximum price per ton for 2-ton lots, d/d ; white seal, £207 10s. ; green seal, £206 10s. ; red seal, £205.

Rubber Chemicals

Antimony Sulphide.—Golden, 2s. 5½d. to 3s. 6d. per lb. Crimson, 3s. 9d. to 5s. per lb.

Carbon Bisulphide.—£65 5s. per ton, according to quality.

Carbon Black.—6d. to 8d. per lb., according to packing.

Carbon Tetrachloride.—£74 10s. per ton.

India-rubber Substitutes.—White, 1s. 9d. to 2s. 2d. per lb. ; dark, 1s. 7¾d. to 2s. 0¾d. per lb.

Lithopone.—30%, £77 per ton.

Mineral Black.—£7 10s. to £10 per ton.

Mineral Rubber, 'Rupron.'—£20 per ton.

Sulphur Chloride.—British 48s. 6d. per cwt.; Imported £120 per ton.

Vegetable Lamp Black.—£49 per ton.

Vermilion.—Pale or deep, 15s. 6d. per lb. for 7-lb. lots.

Nitrogen Fertilisers

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station, £16 18s.

Compound Fertilisers.—Per ton in 6 ton lots, d/d farmer's nearest station, I.C.I. Special No. 1, £27 9s.

'Nitro-Chalk.'—£12 9s. 6d. per ton in 6-ton lots, d/d farmer's nearest station.

Sodium Nitrate.—Chilean agricultural for 6-ton lots d/d nearest station, £30 15s. per ton.

Coal-Tar Products

Benzole.—Per gal, ex works : 90's, 3s. 8½d. ; pure, 3s. 11½d. ; nitration grade, 4s. 2½d.

Carbolic Acid.—Crystals, 1s. 6d. to 1s. 8d. per lb. Crude, 60's, 8s. MANCHESTER : Crystals, 1s. 6d. to 1s. 8d. per lb., d/d crude, 5s. 9d., naked, at works.

Creosote.—Home trade, 10d. to 1s. 2d. per gal., according to quality, f.o.r. maker's works. MANCHESTER : 11d. to 1s. 3d. per gal.

Cresylic Acid.—Pale 99%, 5s. 8d. per gal. ; 99.5/100%, 5s. 10d. American, duty free, for export, 7s. 6d. to 8s. 6d. naked at works.

Naphtha.—Solvent, 90/160°, 4s. 2½d. per gal. for 1000-gal. lots ; heavy, 90/190°, 3s. 8d. per gal. for 1000-gal. lots, d/d. Drums extra : higher prices for smaller lots.

Naphthalene.—Crude, ton lots, in sellers' bags, £18 16s. 3d. to £34 per ton according to m.p. ; hot-pressed, £50 to £60 per ton, in bulk ex works ; purified crystals, £68 10s. to £79 3s. 4d. per ton.

Pitch.—Medium, soft, home trade, 130s. per ton f.o.r. suppliers' works ; export trade, 200s. per ton f.o.b. suppliers' port. MANCHESTER : £6 10s. f.o.r.

Pyridine.—90/160°, 42s. 6d. per gal. MANCHESTER : 40s. to 42s. 6d. per gal.

Toluol.—Pure, 4s. 7½d. per gal. MANCHESTER : Pure, 4s. 7½d. per gal. naked.

Xylol.—For 1000-gal. lots, 5s. 1½d. per gal., according to grade, d/d.

Intermediate and Dyes
(Prices Nominal)

***m*-Cresol** 98/100%.—3s. 9d. per lb. d/d.

***o*-Cresol** 30/31° C.—1s. 4d. per lb. d/d.

***p*-Cresol** 34/35° C.—3s. 9d. per lb. d/d.

Dichloraniline.—2s. 8½d. per lb.

Dinitrobenzene.—8½d. per lb.

Dinitrotoluene.—48/50° C., 9½d. per lb. ; 66/68° C., 1s.

***p*-Nitraniline.**—2s. 11d. per lb.

Nitrobenzene.—Spot, 5½d. per lb. in 90-gal. drums, drums extra, 1-ton lots d/d buyers' works.

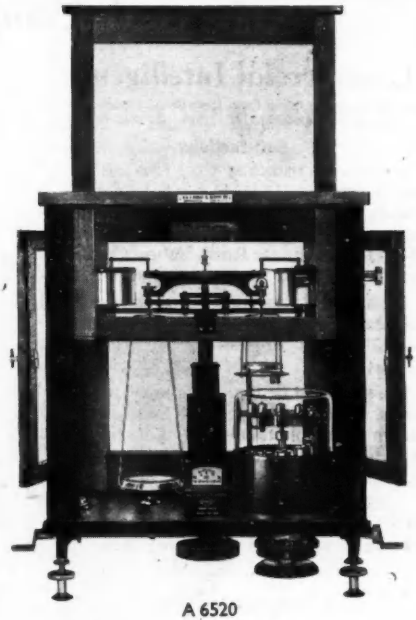
Nitronaphthalene.—1s. 2d. per lb. ; P.G. 1s. 0½d. per lb.

***o*-Toluidine.**—1s. per lb., in 8/10-cwt. drums, drums extra.

***p*-Toluidine.**—2s. 2d. per lb., in casks.

***m*-Xylidine Acetate.**—4s. 5d. per lb., 100%.

Nivoc Aperiodic Balances



A 6520

available for Immediate delivery

WE would commend for the attention of all users of Aperiodic Balances the following range :—

- Nivoc Aperiodic Balance : 200 gm. ×0.1 mg. A.6500
- Nivoc Semi-Micro Aperiodic Balance : 50 gm. ×0.01 mg. .. A.6510
- Nivoc Automatic Aperiodic Balance : 200 gm. ×0.1 mg. .. A.6520

Despite the heavy demand, planned production enables us to offer the above for IMMEDIATE DELIVERY

Full details on request

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LABORATORY FURNISHERS AND MANUFACTURERS OF SCIENTIFIC APPARATUS

B35

Law & Company News

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Satisfactions

LONDON ALUMINIUM CO., LTD., Birmingham. (M.S., 12/4/52.) Satisfaction 6 March, part of property comprised in mortgage and charge registered 13 December 1949 (31 Stonehouse Road, Sutton Coldfield), has been released from the charge.

R. A. CLEMENTS (LONDON) LTD., chemical manufacturers. (M.S., 12/4/52.) Satisfaction 7 March of mortgage registered 12 August 1948.

ROSS LTD., London, E., optical manufacturers. (M.S., 12/4/52.) Satisfactions 7 March of amount outstanding 1 July 1908 and charges registered 17 May 1911 and 20 November 1918.

CORK CHEMICAL AND DRUG CO., LTD. (M.S., 12/4/52.) Satisfaction 14 January of debentures registered 11 October 1921.

Company News

African Explosives & Chemical Industries, Limited

The first issue of £3,500,000 of 5 per cent Guaranteed Unsecured Registered Notes at par has been made by African Explosives and Chemical Industries, Ltd. The remaining £3,000,000 of Notes (to complete the amount authorised to be issued) will be issued later.

Albright & Wilson, Limited

Group profit for the year 1951, after all charges including tax, attributable to Albright & Wilson, Ltd., was £754,308 (£654,361). The second interim dividend of 10 per cent less tax on ordinary stock is recommended as the final, making a total for the year of 15 per cent. Of the Group profit of £754,308 for the 12 months under review, £370,151 was earned by overseas subsidiary companies. Annual general meeting will be held on 26 May.

Eaglescliffe Chemical Co., Ltd.

Group trading profit of the Eaglescliffe Chemical Company, Limited, Co. Durham, for 1951 rose by £136,000 to £379,000, and the net result was £144,000 compared with £113,000 in the previous year. The company is one of the few new chemical manufacturing equities to be introduced to the Stock Exchange recently. Dividend is maintained at 20 per cent on capital increased by 28 4/7ths per cent share bonus; interim 10 per cent on smaller capital and final 10 per cent on increased capital issued to pay for the acquisition of E. P. Potter and Co., chemical manufacturers, Bolton. A sum of £100,000 is allocated to plant replacement.

Pest Control, Ltd.

The directors of Pest Control, Ltd., which was made a public company early in 1949, have decided not to pay a dividend on ordinary capital for the year ended 30 September, 1951. For the previous year 10 per cent was paid, and a preference dividend has been paid for 1951.

The preliminary statement shows a net profit, before tax, of £90,540. This compares with £88,634 for 1949-50.

The directors explain that, quite apart from the operations on the Gold Coast for which increased borrowing powers are being sought, the group has an appreciably increased order book and in present circumstances they feel that this additional business should be financed as far as possible by the retention of profit. Therefore they feel that the best interests of the shareholders are served by carrying forward the whole of the available profit of last year, which amounts to £52,130, against £24,902.

Edward Webb and Sons (Stourbridge) Ltd.

Arrangements are in hand for the introduction on the Birmingham Stock Exchange of the shares of Edward Webb & Sons (Stourbridge), Ltd., fertiliser manufacturers. The company, which resulted from the merger of two businesses begun in 1812 and 1860, was converted into a public company on 29 February last. Issued capital amounts to £400,000, of which £100,000 is in 6 per cent preference £1 shares and the remainder in ordinary 5s. shares.

Cement from Slag

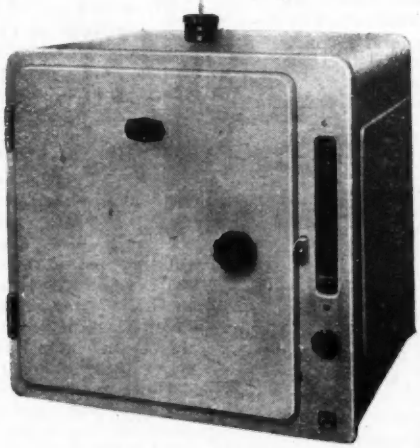
The National Building Research Advisory Committe of South Africa has announced that, after two years of intensive study and research, the Institute has proved that very good cement can be made from Iscor slag. This discovery, it is said, could have a far-reaching effect on the Union's housing.

The T. & M.

TYPE 2 EVEN OVEN

(Specifically designed for forced air circulation)

"FOREVER EVEN" (if we may be permitted)



No electrical parts inside the oven

Temperature range up to 250° C. (even with forced circulation)

INDIVIDUAL CALIBRATION CHARTS WITH EACH OVEN

CONTINUOUS HEATER LENGTH WITH FIVE YEAR GUARANTEE

SLOW MOTION DIAL CONTROL *WITHOUT KNOB*

FAN ASSEMBLY *DESIGNED TO BE SELF COOLING* AND WITH BRUSHLESS MOTOR

(so that the Oven can be used up to 250° C. without shortening motor life!)

HEAT FEED BACK CONTROL AS IN OUR THERMOSTAT BATHS

(but with Al/Invar bi-metal operation in place of Mercury)

It was designed for a fan so that stabilisation of load is much quicker than in any normal oven

As we are producing these in really large numbers the price is surprisingly low

FOR LESS IMPORTANT WORK, WE ALSO MAKE IT WITHOUT THE FAN ASSEMBLY AS TYPE 1

– FOR – *"Service to Science"*

TOWNSON & MERCER LTD.

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Next Week's Events

MONDAY, 28 APRIL

Institution of the Rubber Industry
Manchester: Engineers' Club, Albert Square, 6.15 p.m. Annual general meeting.

TUESDAY, 29 APRIL

Society of Instrument Technology, Ltd.
London: Manson House, Portland Place, 6.30 p.m., joint meeting with Control Section. Dr. W. E. Hick (Cambridge University): 'Why the Human Operator?'

Institution of Structural Engineers
Manchester: Reynolds Hall, College of Technology, 6.30 p.m. Dr. J. A. L. Matheson: 'Plasticity and Structural Design.'

WEDNESDAY, 30 APRIL

Royal Society of Arts
London: John Adam Street, Adelphi, W.C.2, 2.30 p.m. Walter R. Bennett: 'Amenities in Factory Design.'

THURSDAY, 1 MAY

The Chemical Society
Bangor: University College of North Wales, 5.45 p.m., with the University College of North Wales Chemical Society. Professor John Read: 'Humour and Humanism in Chemistry.'

The Royal Society
London: Burlington House, Piccadilly, W.1, 10.30 a.m. W. T. Astbury will open a discussion on: 'The Structure of Proteins.'

Leeds Metallurgical Society
Leeds: University, 7 p.m. Annual general meeting, followed by Junior Members' papers.

Institute of Packaging
London: Waldorf Hotel, 6 p.m. Southern Area. E. J. Gooding (Rockware Glass, Ltd.): 'Glass Containers.'

FRIDAY, 2 MAY

The Chemical Society
Newcastle-upon-Tyne: King's College, 5.30 p.m. Bedson Club Lecture. Dr. J. S. Anderson: 'Recent Advances in the Chemistry of the Heaviest Elements.'

The Royal Institution
London: 21 Albemarle Street, W.1, 8 p.m. Dr. W. D. Wright (Professor of Technical Optics, Imperial College of Science and Technology): 'New Studies on Defective Colour Vision.'

Manchester Federation of Scientific Societies
Manchester: Engineers' Club, Albert Square, 5.30 p.m. Annual dinner; 6.30 p.m. Dinner.

Society of Glass Technology
St. Helens: Gas showrooms, Radiant House, 6 p.m. Annual general meeting, followed by 'Question Box.'

SATURDAY, 3 MAY

Institution of Chemical Engineers
Birmingham: University, Edmund Street, 3 p.m. Midlands Branch. A. M. Hucheson: 'Stainless Steel in Chemical Plant.'

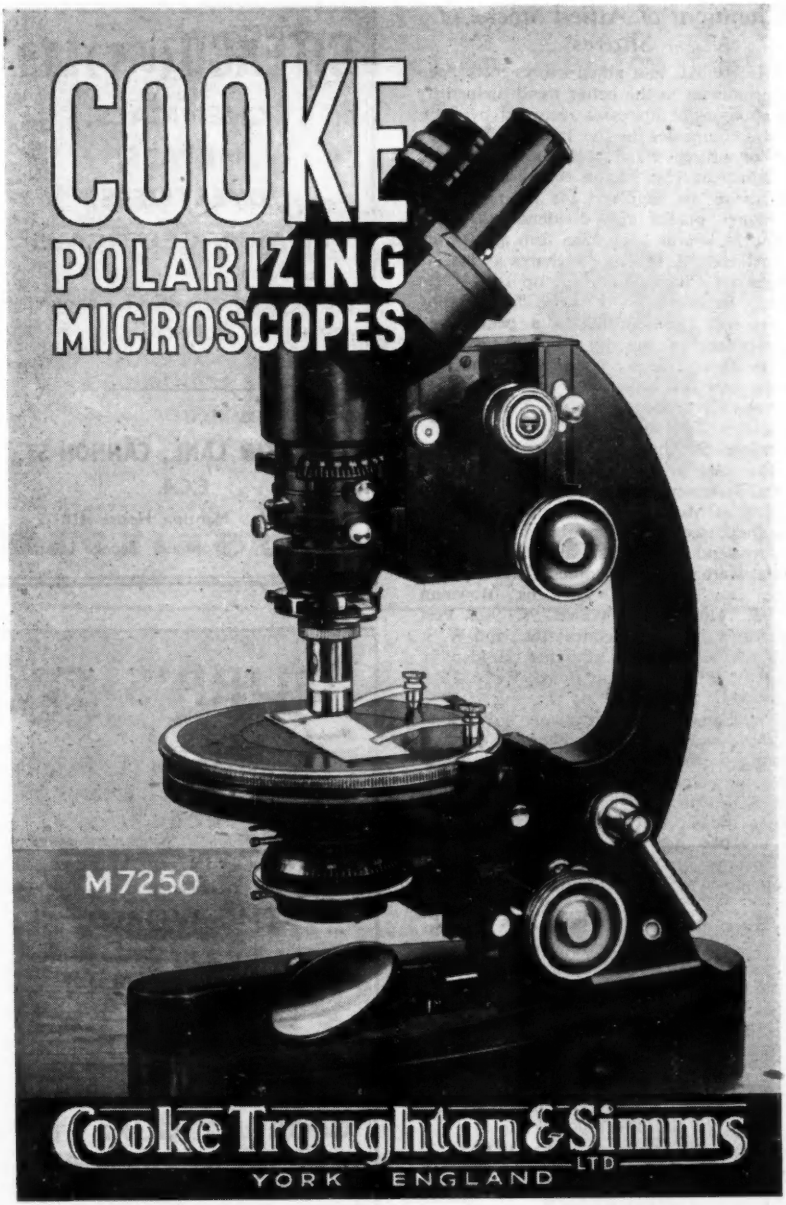
A Pharmaceutical Centenary

PHARMACEUTICAL discoveries in the last 100 years had given fresh hope and life to millions who would formerly have been the victims of disease or even death, declared the Earl of Home, Minister of State for Scottish Affairs, when he proposed the toast of the Scottish Department of the Pharmaceutical Society of Great Britain, at the dinner held in Edinburgh on 16 April to celebrate its centenary.

However much it might go against tradition and against the principles of education, the universities must turn more of their resources to technology, said Mr. Hugh N. Linstead, M.P., the society's secretary, proposing 'The University of Edinburgh'. 'We are a poor country in a competitive world,' he added. 'We can only live by creating and exporting the finest scientific devices.' Replying, Sir Sydney Smith, dean of the University's Faculty of Medicine, said their professions had walked side by side and the great reliance the medical profession always placed on the pharmacists had been fully justified.

Encouragement of original research in pharmacy had always been the aim of the Pharmaceutical Society, avowed Professor F. G. Marrian, Professor of Chemistry in Relation to Medicine at Edinburgh University, who proposed the toast of 'The Pharmaceutical Society'.

This was responded to by the president, Mr. F. C. Wilson, who afterwards invested Mr. H. T. Thomas, chairman of the Scottish executive, with a new badge of office.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Chemical & Allied Stocks & Shares

CHEMICAL and allied shares have been prominent in the better trend, helped by the good profit increases recorded by well-known companies in the industry. At the time of writing, Eaglescliffe 5s. shares have been firm at 15s. 9d. on the results, while Brotherton 10s. shares at 24s. 3d. responded to higher profits and dividend. William Blythe 3s. shares have been firm at 10s. 6d. and Albright & Wilson 5s. shares at 16s.

Imperial Chemical moved up to 44s. on market expectations that the forthcoming results will show profits at a peak level. Maintenance of the 12 per cent dividend was being confidently expected. The new shares, now fully paid, were 42s. 6d.

Fisons have strengthened to 28s., Laporte Chemicals 5s. shares were 9s. 6d., and Monsanto 5s. shares at 26s. moved higher on the past year's results and chairman's annual statement. Although E.P.L. will hit unfairly at Monsanto, the market view was that there seemed reasonable prospects of the dividend being maintained. J. & J. White were 12s.xd., Amber Chemical 2s. shares 2s. 3d., F. W. Berk 6s., Bowman 6s. 9d., Hickson & Welch 9s. 9d., Pest Control 5s., Greeff Chemical 16s., and W. J. Bush 52s. 6d., while Hardman & Holden 5s. shares were 23s. 9d. and Boake Roberts 5s. shares 15s.

Among plastics, higher prices have ruled on the financial results coming to hand showing improved profits, and on the fact that some companies in the industry have a favourable position in regard to E.P.L. British Industrial Plastics 2s. shares were 6s. 3d. Dealings started this week around 21s. 6d. in the 10s. shares of Bakelite, Kleemann were 10s. and British Xylonite 26s. 9d.

British Glues 4s. shares showed firmness at 11s. 9d. and United Molasses at 34s. 3d. responded to the past year's big profit increase and higher dividend. Borax Consolidated were 33s 6d. Unilever 47s., but textile shares receded, including Courtaulds at 38s. 3d., and British Celanese at 25s. 3d.

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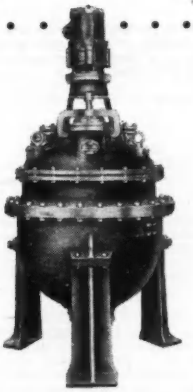
HIGHLY ACID RESISTANT GLASS LINED EQUIPMENT
in cast iron and steel for the chemical and allied industries.

REACTION KETTLES
up to 1500 gall. capacity.

AUTOCLAVES, EVAPORATORS, CONDENSERS, STORAGE TANKS

R.C.D. RUBBER LINING
Acid and alkali resisting for temperatures up to 266°F.



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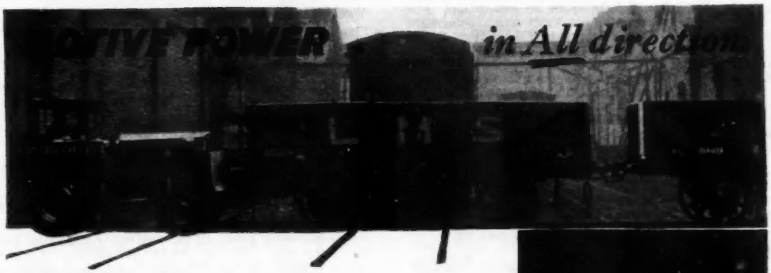

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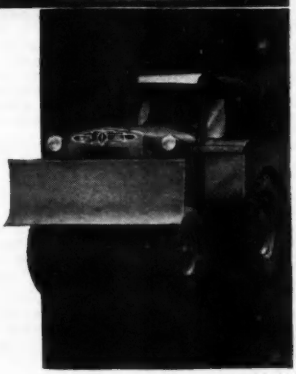
The scope of this outstandingly useful machine is fully dealt with in our latest brochure. May we send you a copy?



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CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive, or a woman aged* 18-59 *inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order,* 1952.

CHEMICAL ENGINEER, with experience of the design and operation of modern plant, is required by a long-established and live Firm of Chemical Manufacturers. Duties will be in the Chemical Engineering Department of the Company, and will cover both development of existing processes and the design of new plant, from pilot plant stage to final commissioning. Apply, in confidence, to **BOX No. C.A. 3133,** THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

CHEMISTS are invited by the **MINISTRY OF SUPPLY** for appointments at the Radiochemical Centre, Amersham, Bucks., to be concerned with the synthesis of compounds labelled with radioactive isotopes, particularly Carbon —14, and with allied research problems. Inclusive salaries for these posts range from £264 to £1,033 and the initial salary for each candidate will depend upon age, qualifications and experience. Some of the posts call for a first or second-class Honours Degree, preferably followed by some research experience, while for others a Higher School Certificate with Chemistry as principal subject is required as a minimum qualification, though higher qualifications may be an advantage. For the senior posts substantial experience in Synthetic Organic Chemistry or in Inorganic Chemistry of the rarer elements is desirable, and for one post experience in Non-ferrous Metallurgy is required. The posts are unestablished, but some carry benefits under F.S.S.U. Application forms obtainable from the **MINISTRY OF LABOUR AND NATIONAL SERVICE, TECHNICAL AND SCIENTIFIC REGISTER (K), ALMACK HOUSE, 26, KING STREET, LONDON, S.W.1,** quoting F.255/52/A. Closing date, May 21st, 1952.

SOUTHERN RHODESIA GOVERNMENT VACANCIES—CHEMISTS, DEPARTMENT OF RESEARCH AND SPECIALIST SERVICES

APPLICANTS must possess a Degree in Chemistry (preferably with honours). Knowledge of soils and soil surveys would be an advantage but is not an essential requirement. Successful applicants may be required to spend up to six months of the year in the field when camp equipment is provided. A subsistence allowance of 12s. 6d. per diem will be payable during absence from headquarters.

SALARY SCALE: £468 by £66 to £600 by £34 to £668 by £33 to £800 by £100 to £900 by £40 to £1,140 per annum.

A cost-of-living allowance, at present approximately 27 per cent of salary, and marriage and children's allowances are also payable.

The commencing salary may be higher than the minimum of the scale, depending on the type of the degree and previous experience. Applicants holding a specialised degree involving a four-year course at a University in the British Empire, would commence on the £600 per annum step.

Application forms and further particulars may be obtained from the **SECRETARY, RHODESIA HOUSE, 429, STRAND, LONDON, W.C.2,** to whom completed forms should be returned by May 14th.

SITUATION VACANT

YOUNG LADY, aged approximately 22-30 years, required for the Chemical Laboratory of a large Electrical Engineering Company in the West London area. Applicants should have studied Chemistry up to H.S.C. or Inter B.Sc., standard, and should be experienced in Chemical Analysis. 5-day week, good conditions and pay. Write, giving details of age and previous experience, to **BOX No. C.A. 3136,** THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

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PROCESS PLANT

Strip **PICKLING AND WASHING PLANT,** comprising 33 ft. centres by 16½ in. Acid resisting horizontal Link **CONVEYOR,** motorised 400/3/50, lead-lined **PICKLING CHAMBER** 5 ft. long by 2 ft. by 2 ft. with four 1 in. spray pipes supplied from totally enclosed lead-lined TANK, 7 ft. 6 in. by 2 ft., armoured Vitreon **ACID PUMP** motorised, **WASHING CHAMBER** 21 ft. long with totally enclosed **LEAD-LINED TANK,** 6 ft. by 2 ft. by 2 ft.

De-airing type **PUG MILL** by Bonnot. Primary chamber 4 in. diam., secondary worm extruder 3 in. diam.—3-in. discharge with 7½ in. by 9 in. opening. Of aluminium construction with S. steel shaft and worms. Motorised 220/440/3/50.

Two steam-jacketed **ROTARY VACUUM DRYERS,** each 17 ft. 3 in. by 4 ft. 6 in. diam. Manhole in barrel with cover. Mounted on roller tracks and driven through glanded trunnion bearings. Discharge through S.J. chamber.

Semi-muffle **OIL-FIRED FURNACE** by Incandescent Heat Co., fitted twin burners, brick lined, 3 ft. by 2 ft. by 1 ft. 6 in. high. Temp. range 0-1,300° C.

Gas-heated **CORE DRYING OVEN** by Ballard, of steel casing with 4 drawer trays. Int. dimensions, 6 ft. 8 in. by 6 ft. 11 in. by 5 ft. 2 in.

Lead-lined M.S. **STORAGE TANK,** 35 ft. long by 9 ft. diam. Welded steel construction, lined 3/16th in.-¼ in. lead sheet. Two 4-in. and one 3-in. fixed flange connections.

BOTTLE RINSING M/C., by Thomas & Hill. Chain conveyor type, 12 ft. centres, double-row bottle fixtures. 132 hd. Rotary jet rinsing. Capacity 150 doz. half or pint bottles per hour. Motorised 400/3/50.

Four-head **DOUBLE SEAMER** by Rhodes, for size A1 and A.J.T. Cans, complete with chucks to suit. Pulley drive.

LABELLING M/C., by Rawsons, for pint or 16 oz. size flat or square. Capacity, 24-30 per min. Numbering device. Motorised 400/3/50. Unit mounted on rubber-tyred wheels.

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FOURTEEN various open-top **STORAGE TANKS** riveted, capacities from 300 gallons to 9,800 gallons Last used for oil or varnish.

1½, 2½ and 3½ size belt-driven **DISINTEGRATORS** by Christy & Norris or Harrison Carter.

Size No. 3 Junior Hammamac **HAMMER MILL** with fan and cyclone, also No. 1 size Miracle **GRINDING MILLS**

Robinson 3-sheet No. 1 size **CENTRIFUGAL DRESSING MACHINE** for dry powders etc.

Four **ROTARY BOWL MIXERS,** 5 ft. diam., cast iron built, inclined agitators by Baker Perkins.

Kek **GRINDING MILL,** square pin type, with grinding discs 13 in. diam., including circular delivery bin with single outlet.

Large unjacketed **WERNER MIXER,** belt and gear driven, hand tipping, double " Z " arms, pans 31in by 45 in by 36 in. deep.

No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER OR INCOPORATOR.** Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double " U "-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears, covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6 ft. by 4 ft. high to the to of the tipping screw.

No. 209 One **HORIZONTAL " U "-SHAPED MIXER** steel built, riveted, measuring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. long by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

Two **FILTER PRESSES,** each fitted 68 wood recessed plates, 2 ft. 8 in. square, centre fed, with enclosed bottom corner delivery, cloth clips and belongings.

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GRAVITY Roller Conveyor several lengths, Rolls. 2½ in. diam. by 16 in. 3 in. centres. Good condition. **THOMPSON & SON (MILLWALL), LIMITED, CUBA STREET MILLWALL E.14.** (Tel.: East 1844.)

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FILM DRYERS or COOLING ROLLS, 9 ft. by 4 ft. diam. Five Roll Water-cooled **STEEL REFINERS,** with 48-in. and 33-in. rolls.

" Werner " Jacketed Twin Blade **TIPPING MIXERS,** 3 ft. by 2 ft. 6 in. by 2 ft. 6 in., 29 in. by 27 in. by 19 in. and 24 in. by 25 in. by 20 in.

Twin " Z " Blade **TIPPING MIXERS,** 43 in. by 40 in. by 28 in., 16 in. by 16 in by 14 in., and Lab. sizes, 5 in. by 4 in. by 4 in. approx.

Two unused " Weir " **CONDENSERS,** 100 sq. ft., brass tubes.

W.S. **AUTOCLAVES,** 2 ft. diam. all lengths up to 18 ft., 100 lbs. w.p.

Rectangular and cyl. **TANKS** up to 12,000 gallons.

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HELE SHAW **HIGH-SPEED ROTARY HYDRAULIC PUMP,** having six double-acting plungers, 2½ in. diam. by 1⅞ in. stroke, delivering approximately 50 gallons p.m. at 700-1,000 lb. per sq. in.

35 h.p. BROOKS SLIP-RING MOTOR, 415 volts, 3-phase, 50 cycles, 1,000 r.p.m., together with oil-immersed starter.

HYDRAULIC INTENSIFIER. Low pressure ram, 22 in. diam. High pressure ram, 9½ in. diam. Stroke approximately 5 ft. Ratio, 5½ : 1 to intensify from 800 lb. to 2 tons per sq. in.

SMALL 2-PLUNGER HORIZONTAL HYDRAULIC PUMP. 2 tons per sq. in. working pressure. Mounted on a tank.

SEVERAL GUNMETAL HYDRAULIC STOP VALVES, ¼ in., ⅜ in., and 1 in.

A JACKSON & CROCKATT PATENT JUNIOR 45 PACKING MACHINE for powder materials.

A NUMBER OF ELECTRIC MOTORS from ¼ h.p. to 12 h.p. Mostly suitable for 400/440 volts, 3-phase, 50 cycles. (Detailed list on application.)

TWO " Centrac " Hand-operated **PASTE FILLING MACHINES.** (Incomplete).

ONE " Centrac " Hand-operated Tube Folding and Closing Machine.

ONE SIFTER MIXER. 3 cwt. capacity. (New condition.)

5 cwt. (approx.) Refined **BEESWAX.**

7 cwt. (approx.) **PARAFFIN WAX.**

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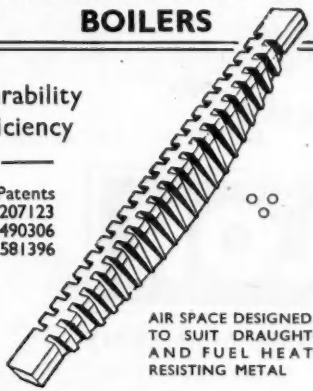
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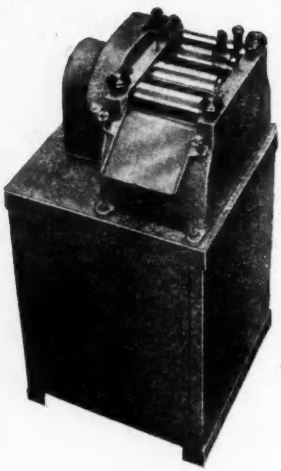

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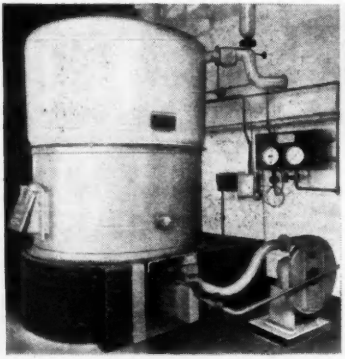

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